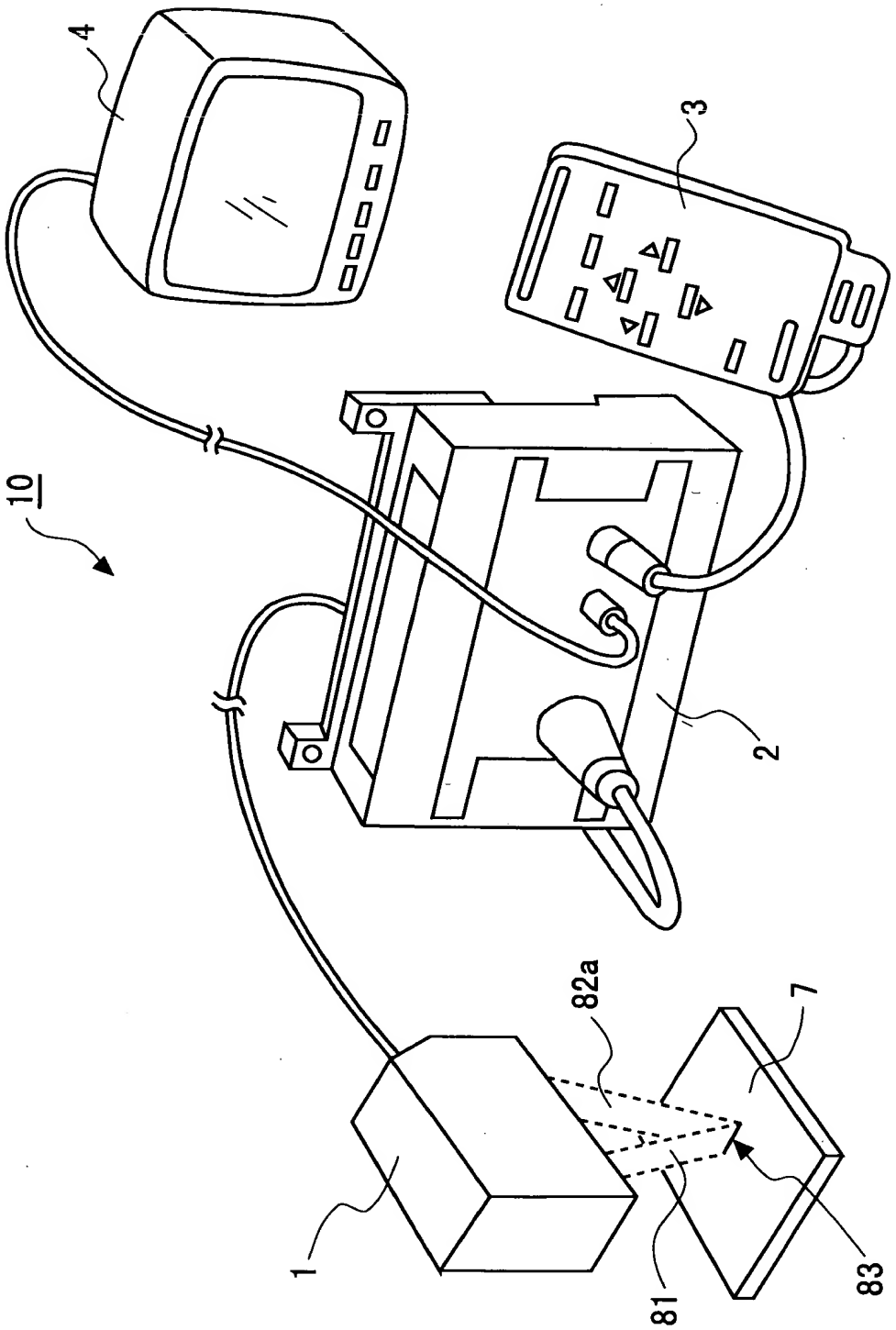
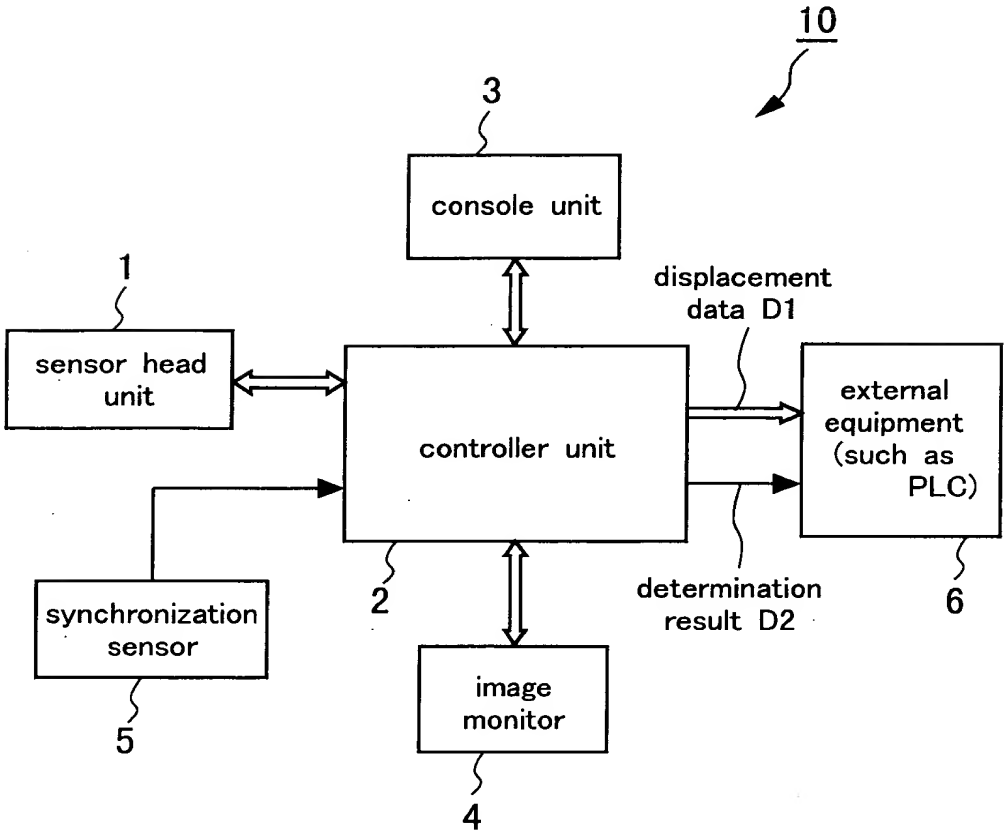
Fig. 1



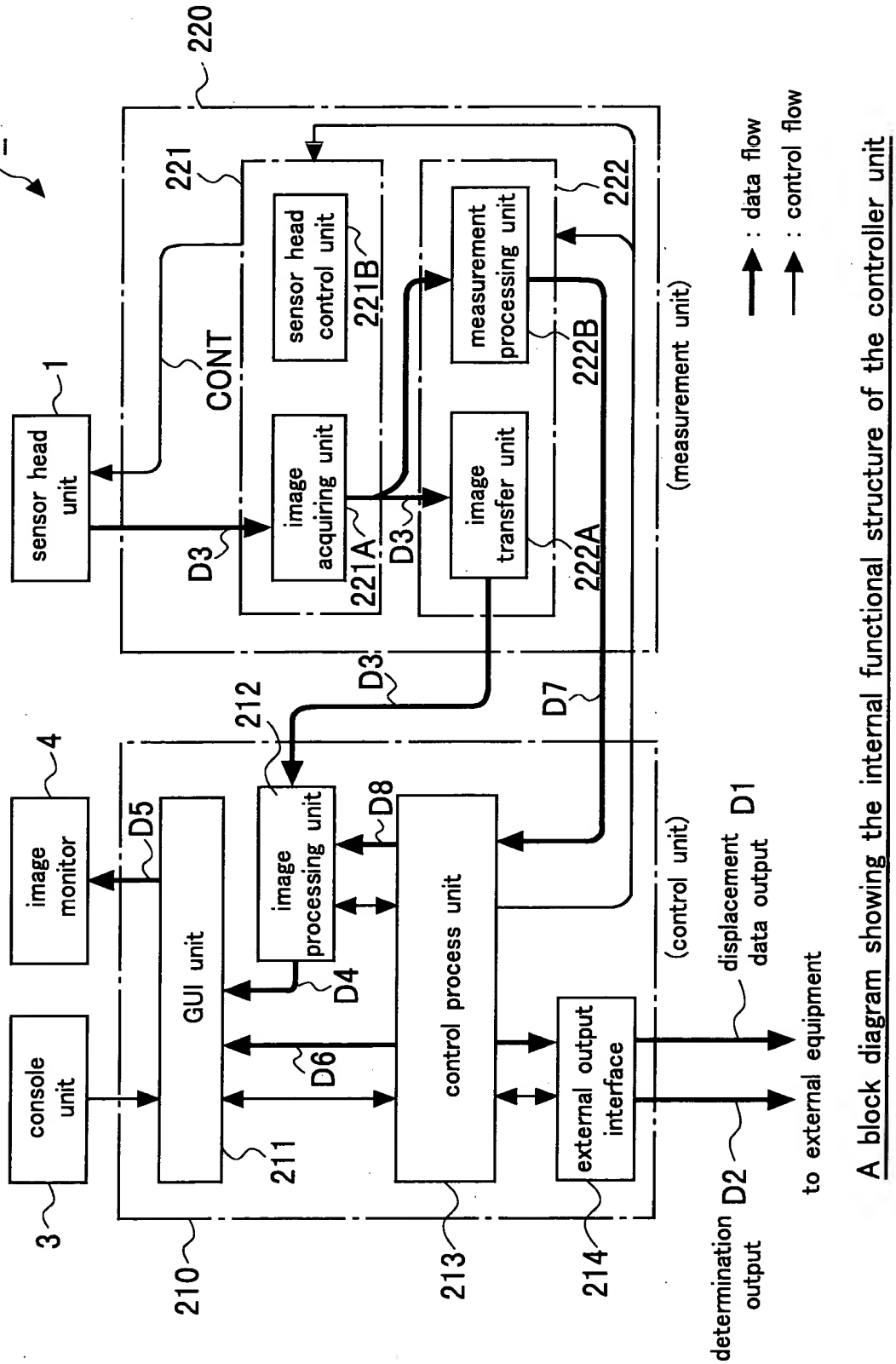
An overall external view of a displacement sensor system embodying the present invention

Fig.2



A block diagram showing the overall electric hardware structure of the displacement sensor system embodying the present invention

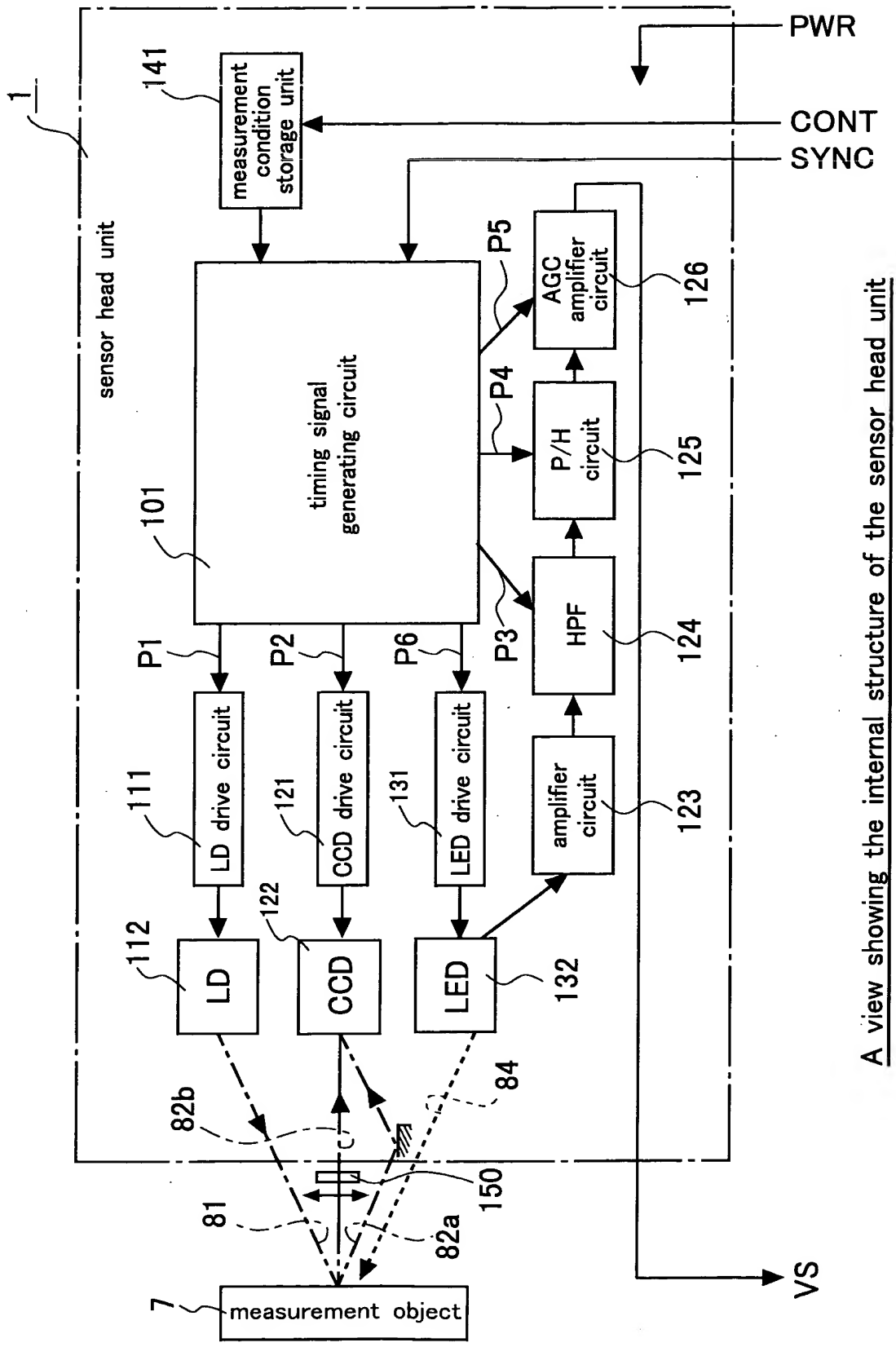
Fig.3



A block diagram showing the internal functional structure of the controller unit

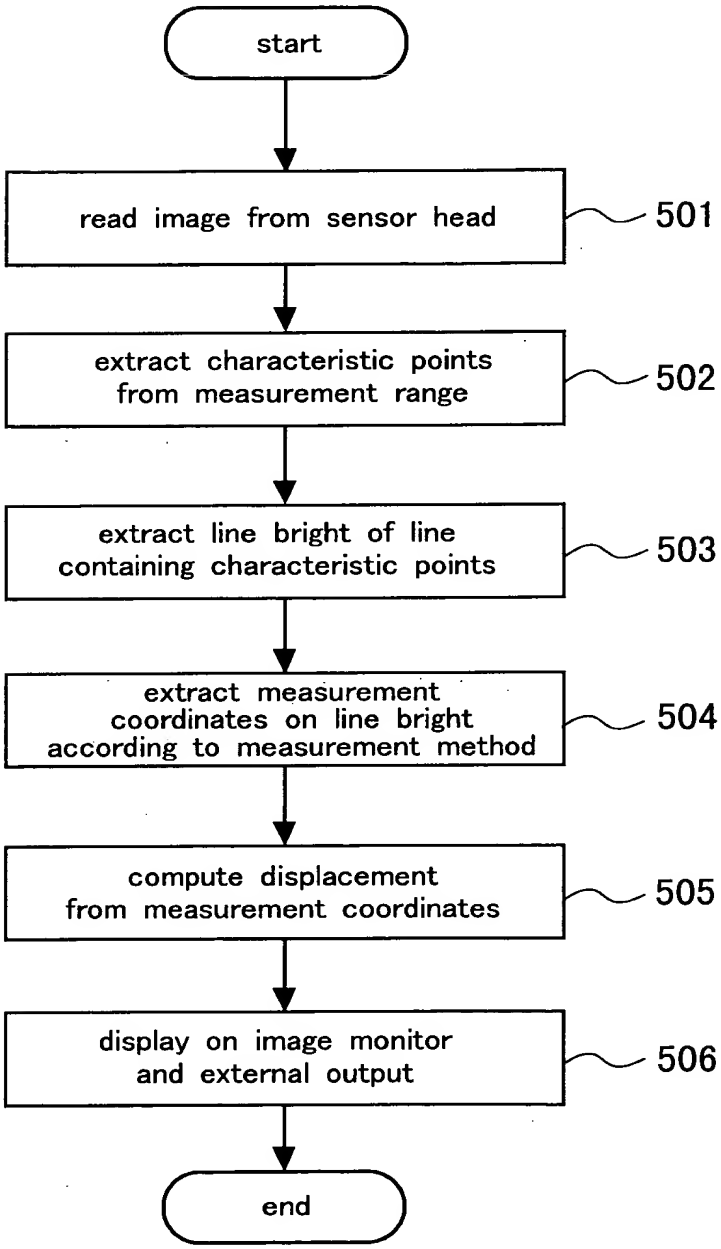
Title: DISPLACEMENT SENSOR
Inventor(s): Nobuharu ISHIKAWA et al.
Atty. Dkt. No.: 058856-0108

Fig.4



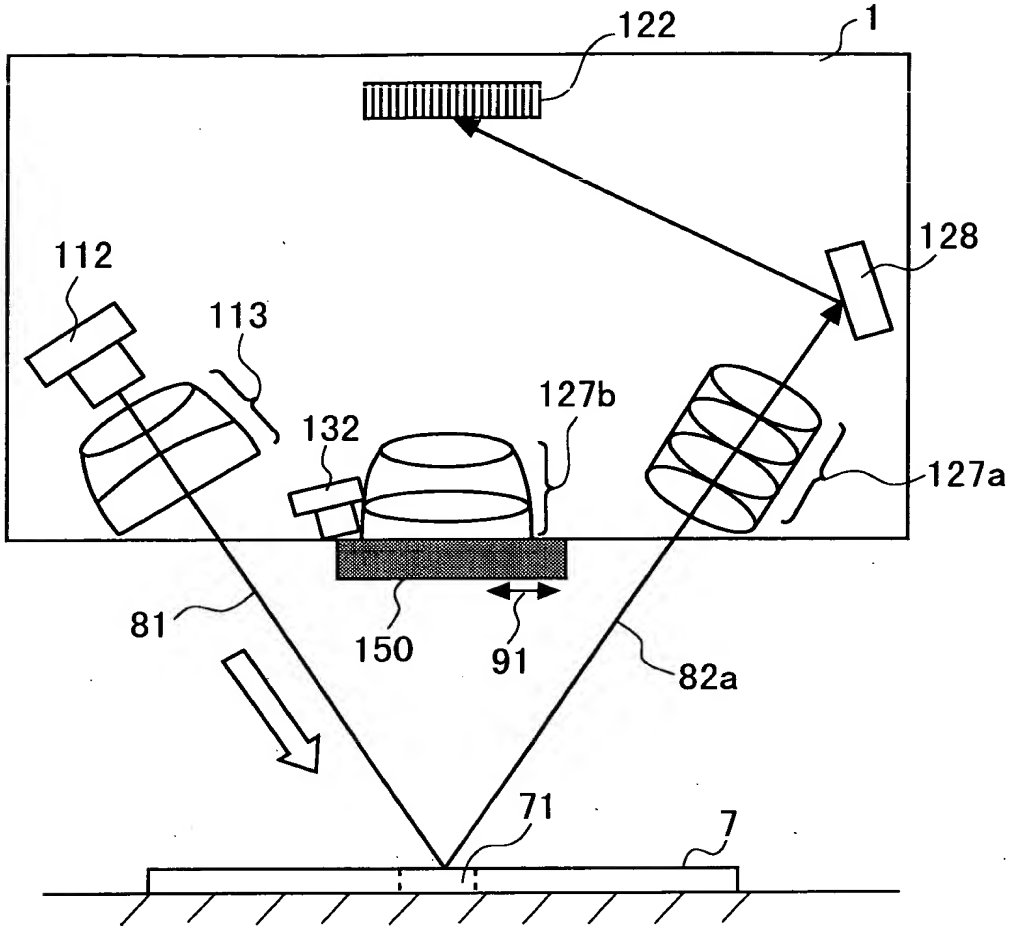
A view showing the internal structure of the sensor head unit

Fig.5

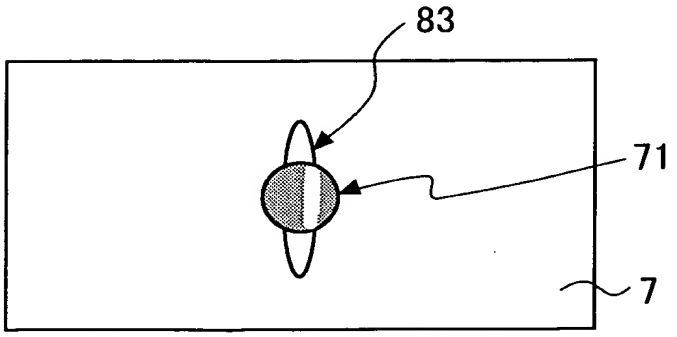


A general flow chart showing the outline of the displacement measurement process of the controller unit

Fig.6



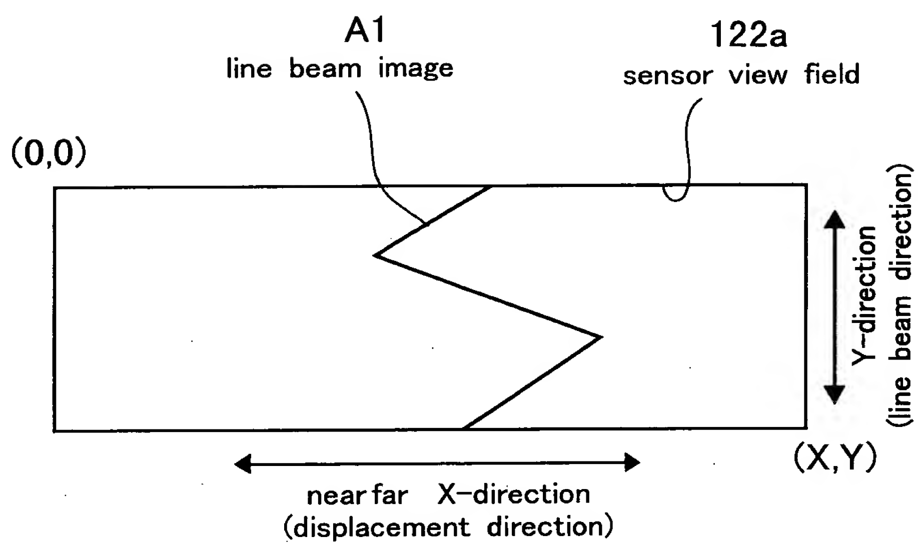
(a) diagram illustrating the measurement mode of the displacement sensor of the present invention



(b) view of the upper surface of the measurement object seen from above

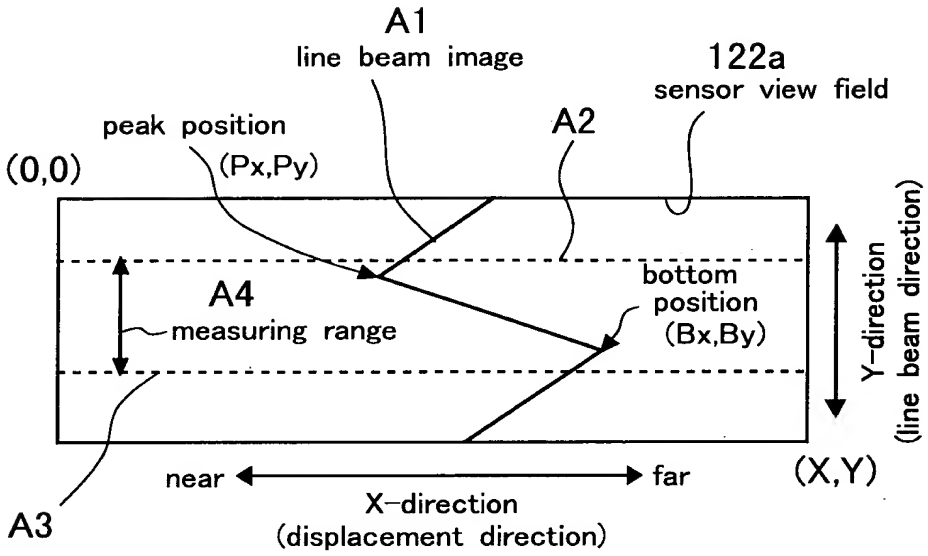
A diagram illustrating the action of the displacement sensor of the present invention under the measurement mode

Fig. 7



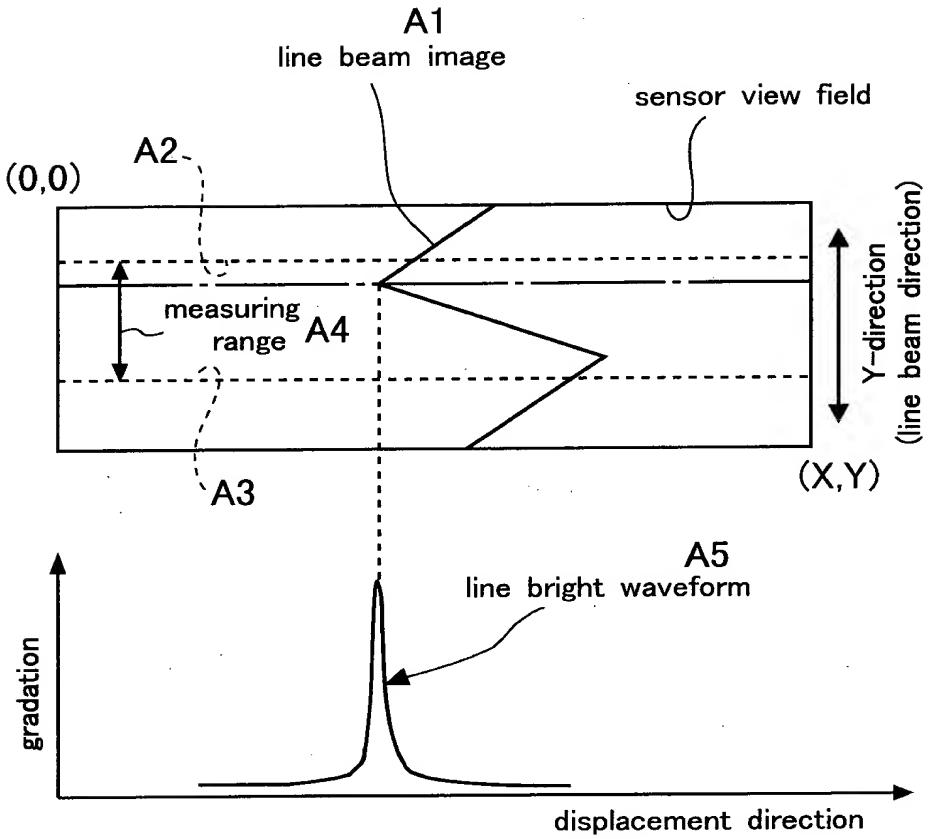
A diagram illustrating the image captured by the CCD in the sensor head unit

Fig.8



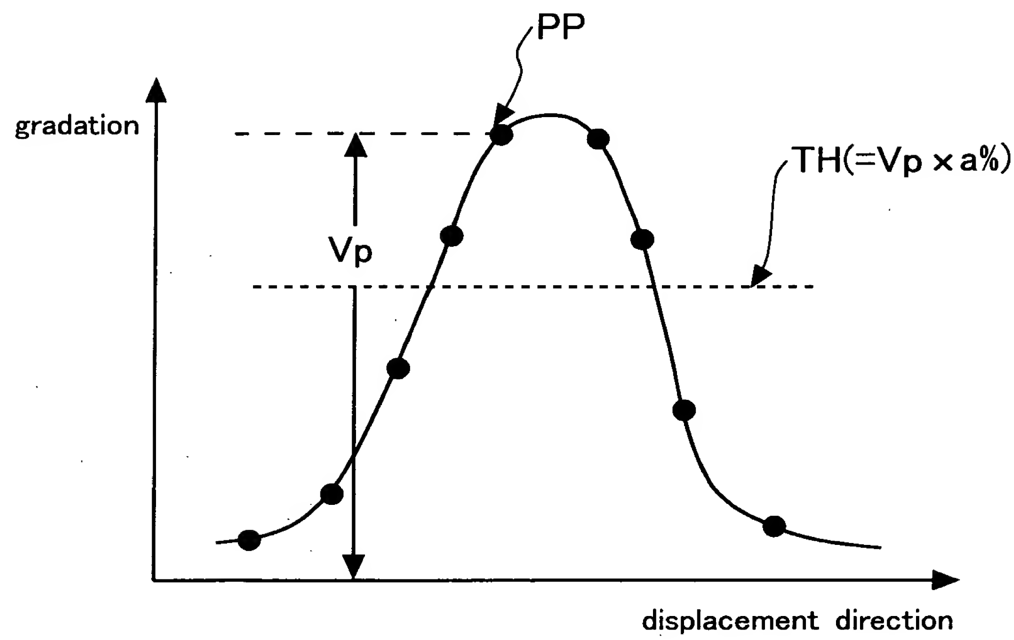
A diagram illustrating the measurement point extraction process in the measurement range

Fig.9



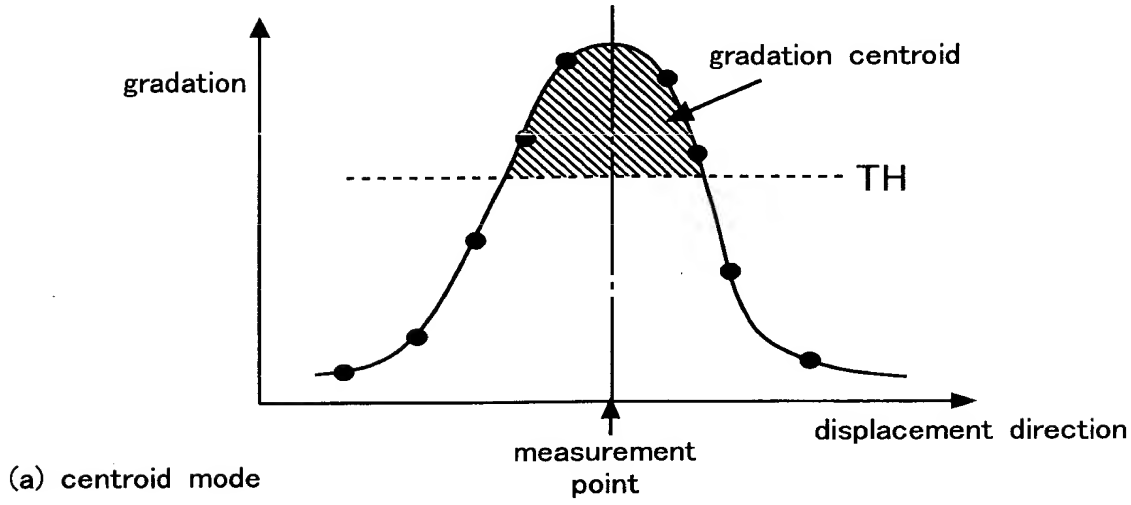
A diagram showing the relationship between the image captured by the CCD and the line bright waveform

Fig. 10

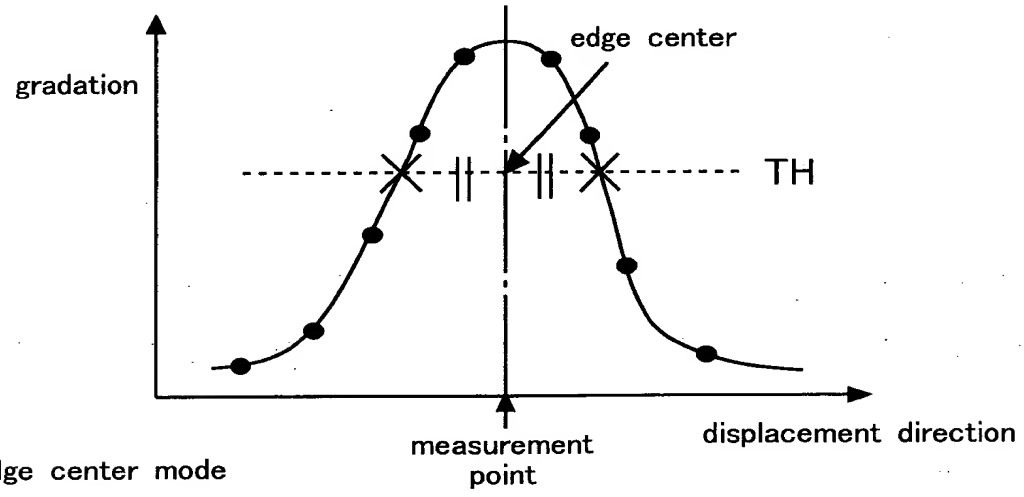


A diagram showing the method of determining a threshold value

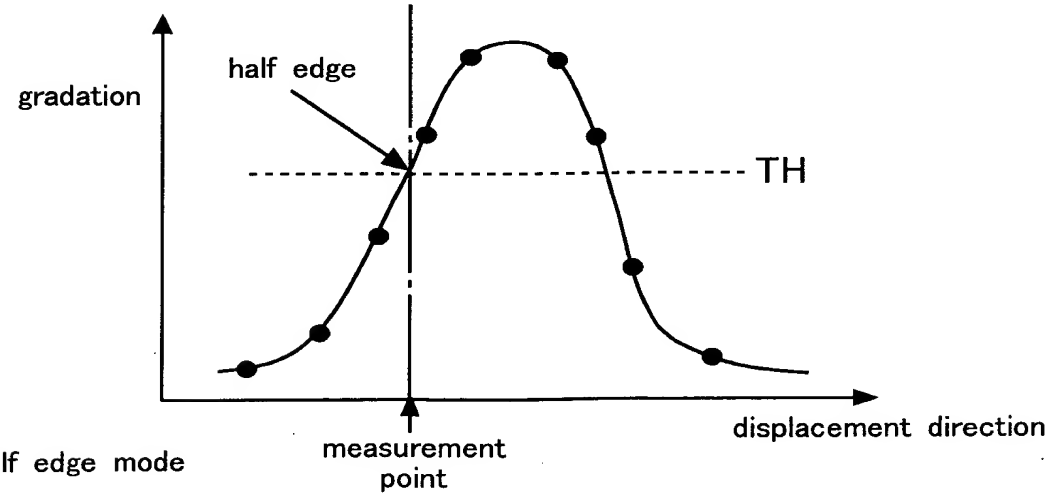
Fig. 11



(a) centroid mode



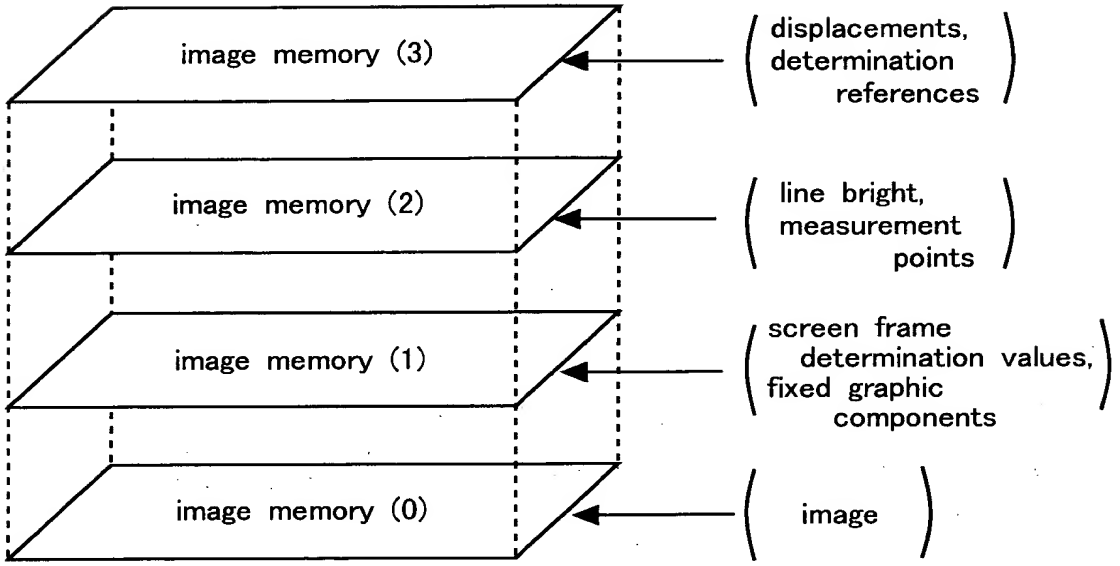
(b) edge center mode



(c) half edge mode

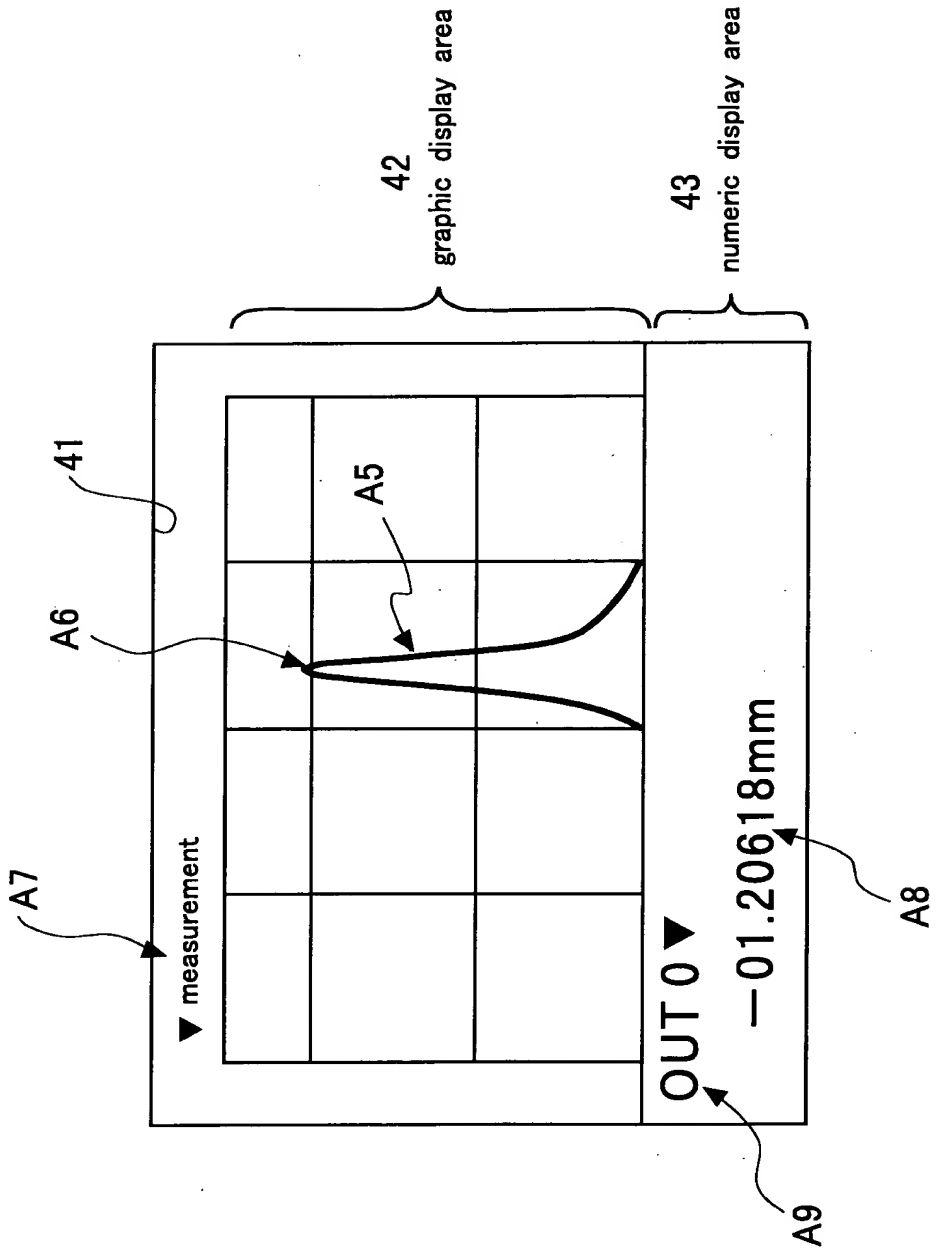
A diagram showing the process of extracting measurement point coordinates

Fig. 12



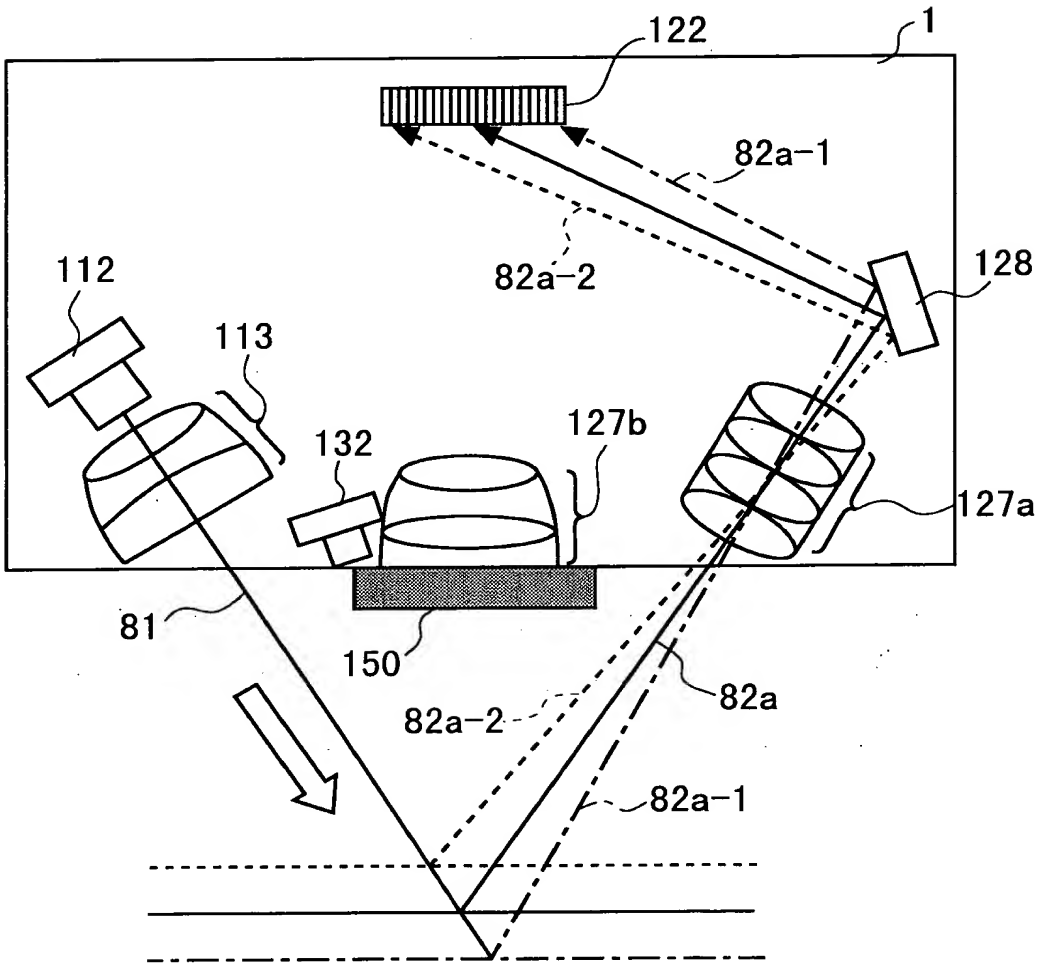
A diagram illustrating the method of generating the image on the monitor screen

Fig.13



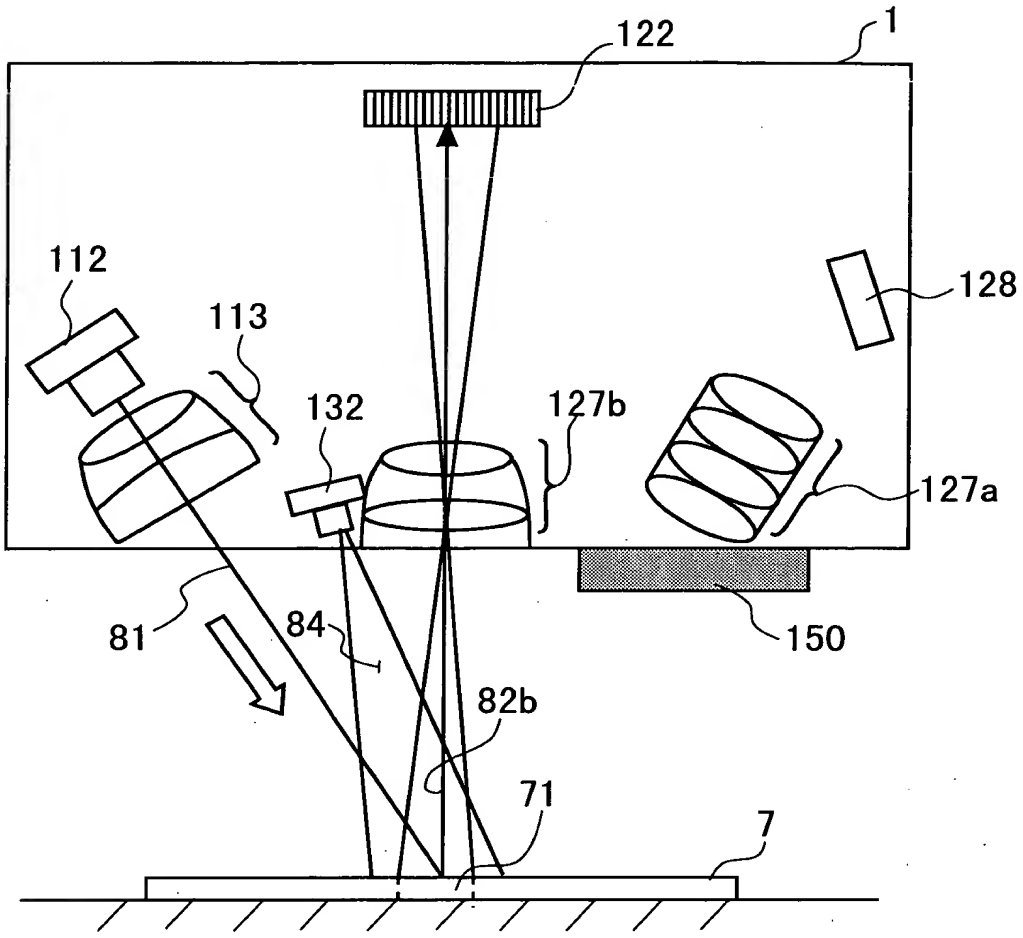
A diagram showing an exemplary monitor screen when the displacement sensor of the present invention is under the measurement mode

Fig. 14

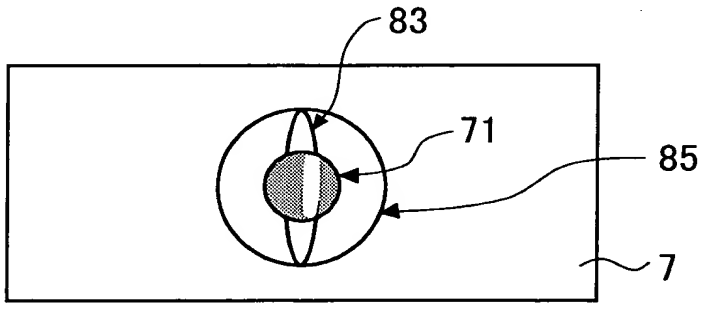


A diagram showing the change in the received light path in the displacement sensor of the present invention when the measurement object moves vertically

Fig. 15



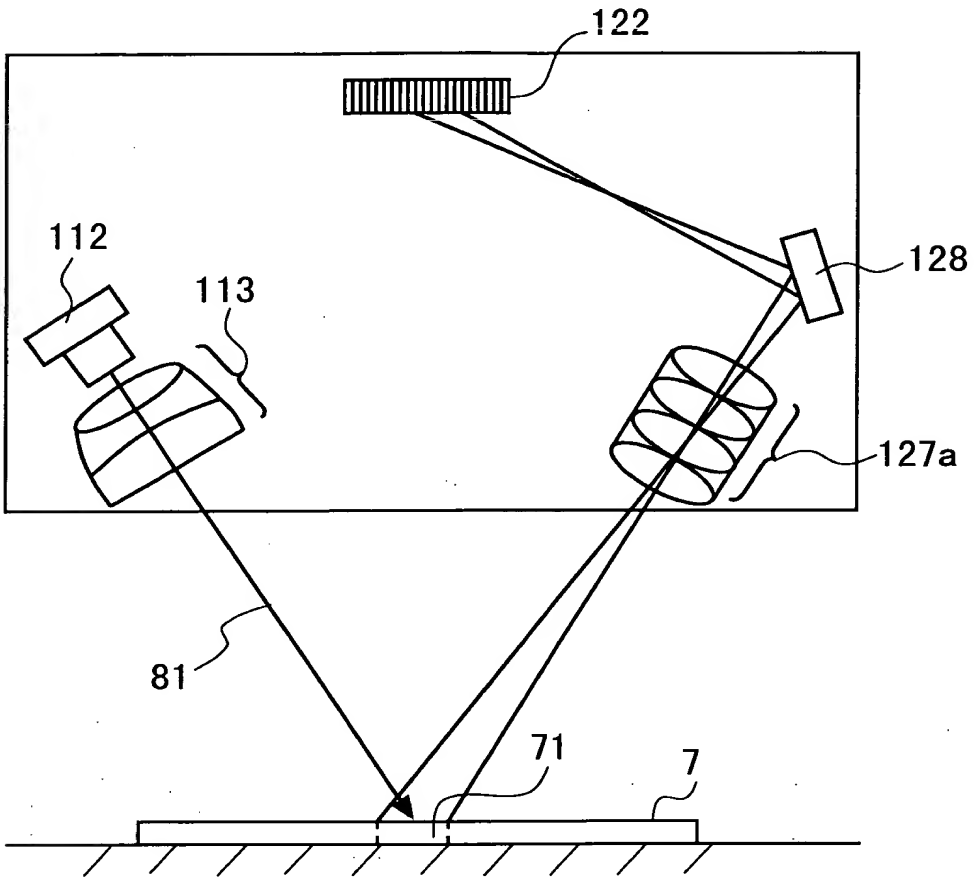
(a) diagram illustrating the observation mode of the displacement sensor of the present invention



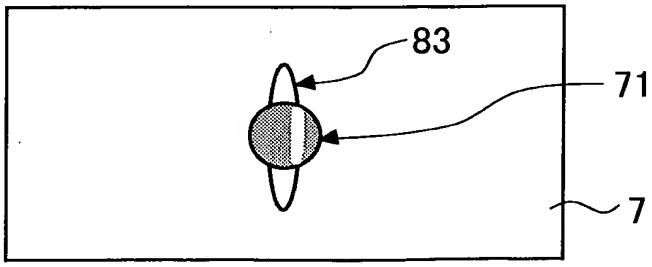
(b) view of the upper surface of the measurement object seen from above

A diagram showing the operation of the displacement sensor of the present invention under the measurement mode

Fig.16



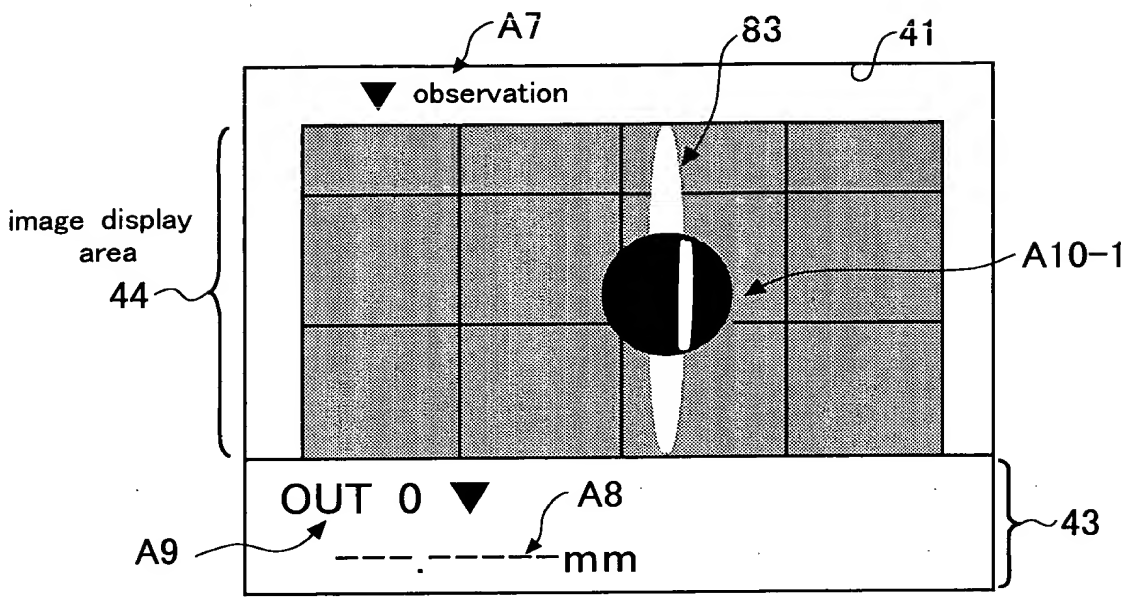
(a) diagram illustrating the observation mode using the measurement light path



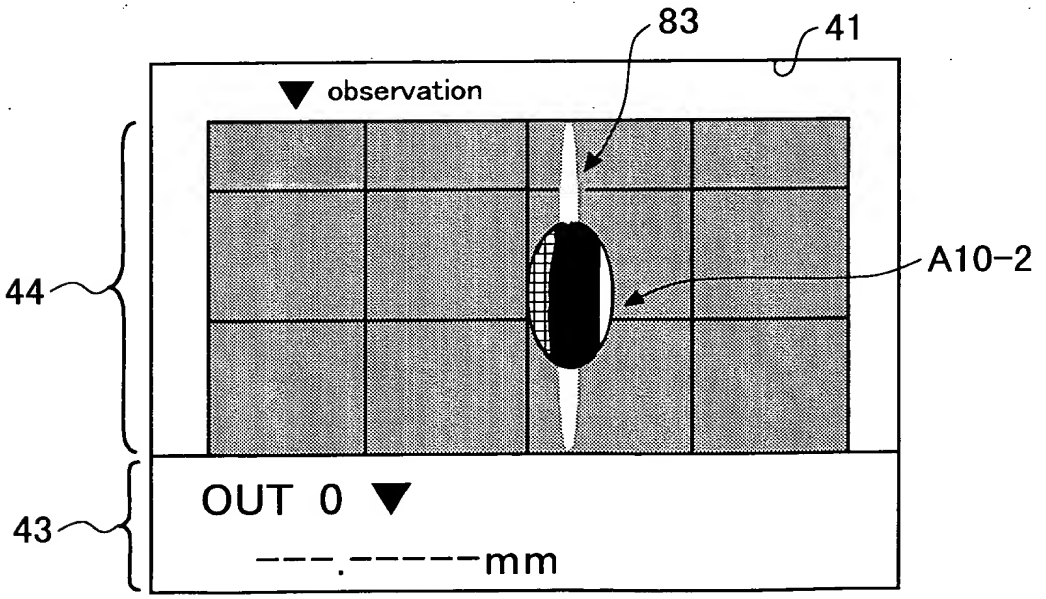
(b) view of the upper surface of the measurement object seen from above

A diagram showing the operation of the displacement sensor of the present invention under the observation mode

Fig. 17



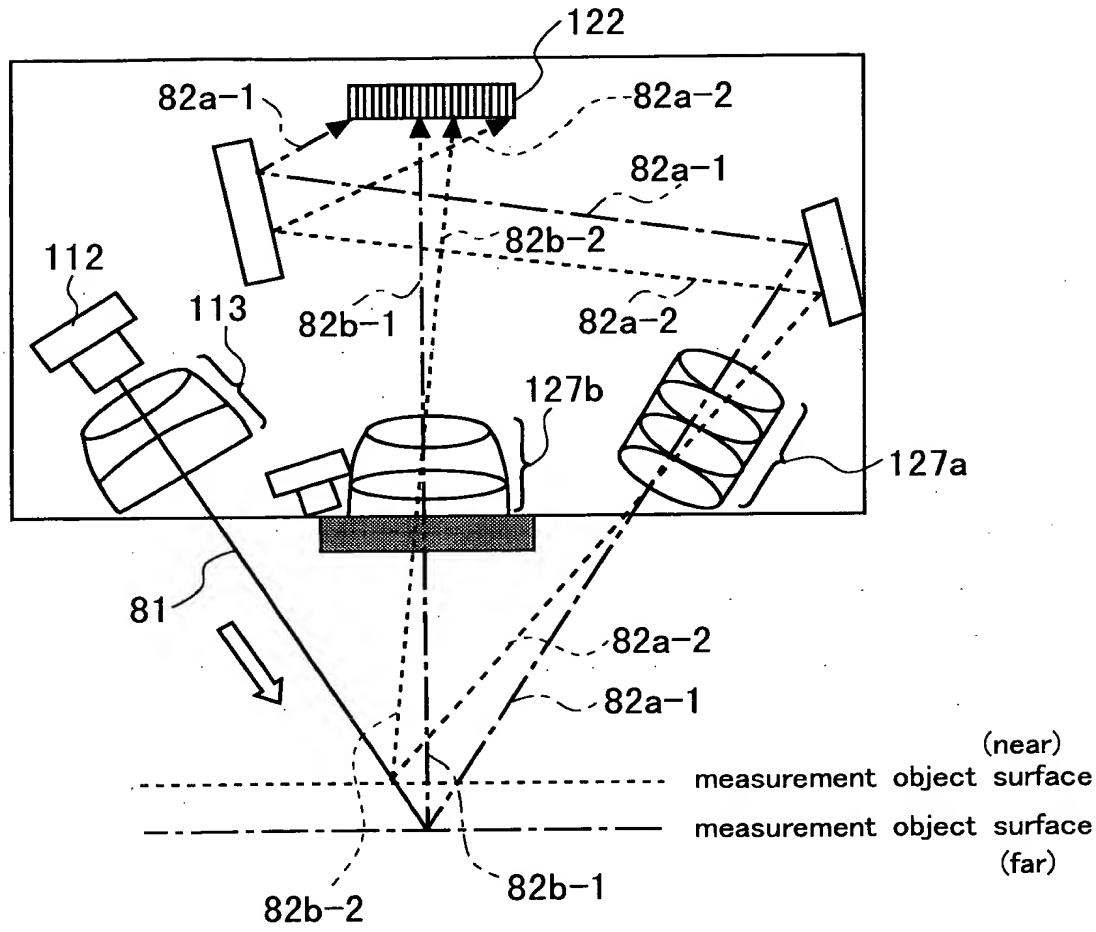
(a) diagram showing an exemplary monitor screen of the displacement sensor of the present invention under the observation mode



(b) diagram illustrating the observation mode using the measurement light path

A diagram comparing the monitor screens
of the displacement sensor of the present invention
and a conventional displacement sensor both under the observation mode

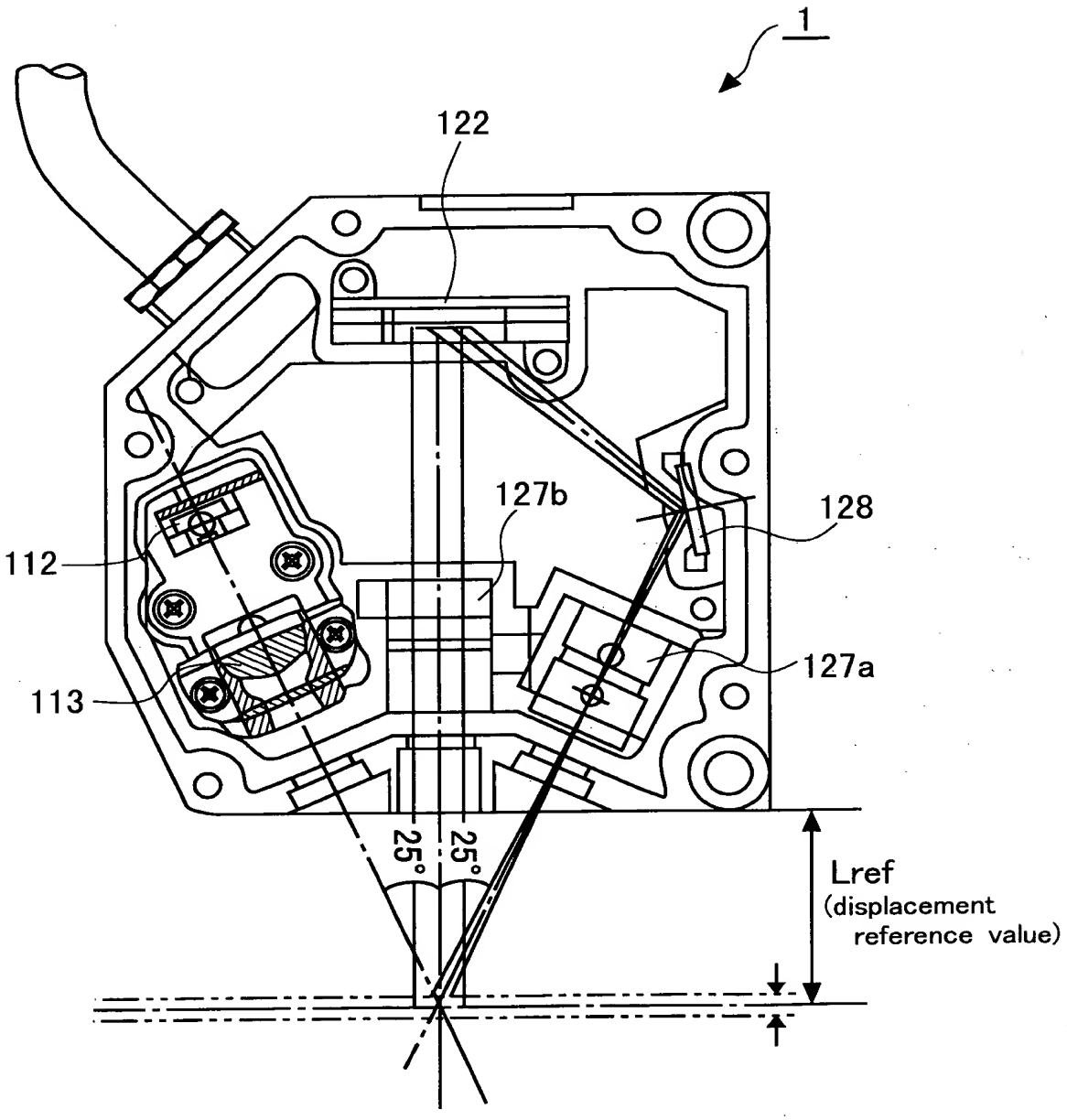
Fig. 18



A view showing a modified embodiment of the sensor head of the present invention

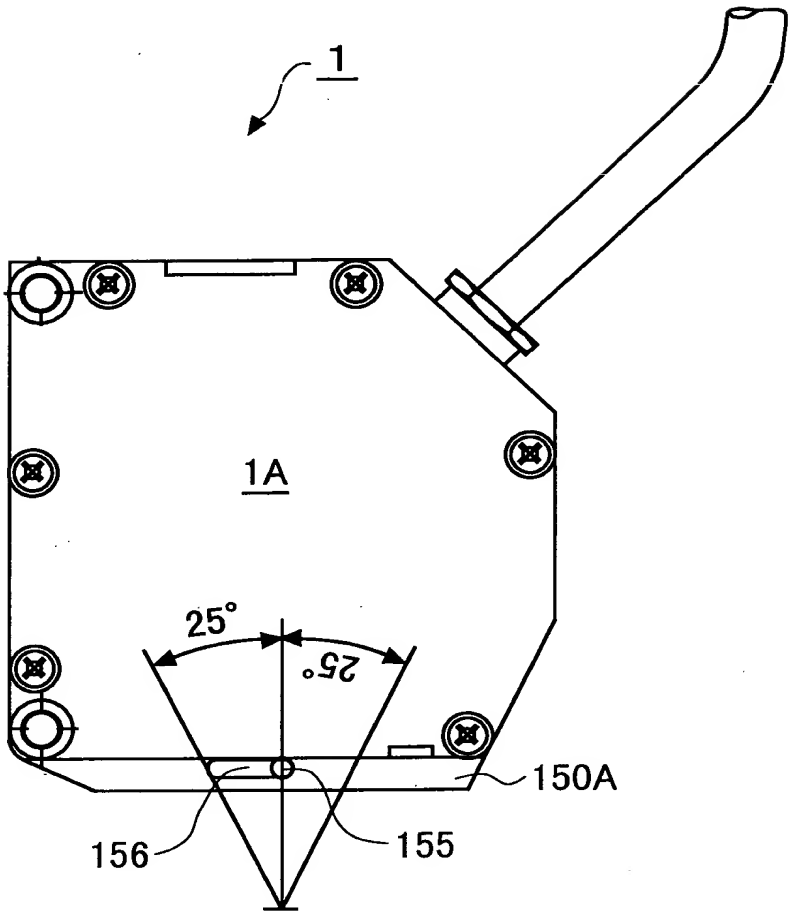
Title: DISPLACEMENT SENSOR
Inventor(s): Nobuharu ISHIKAWA et al.
Atty. Dkt. No.: 058856-0108

Fig.19

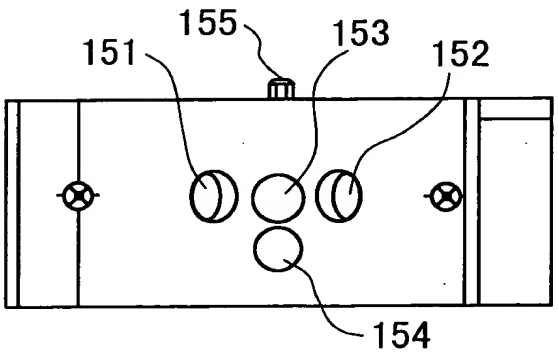


A view showing the interior
of the sensor head unit opening a side of the case

Fig.20



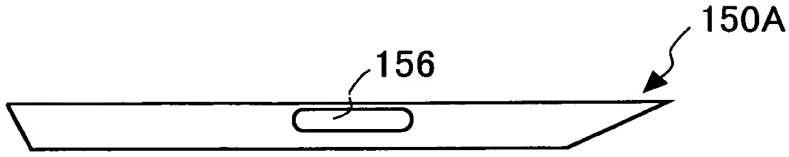
(a) side view



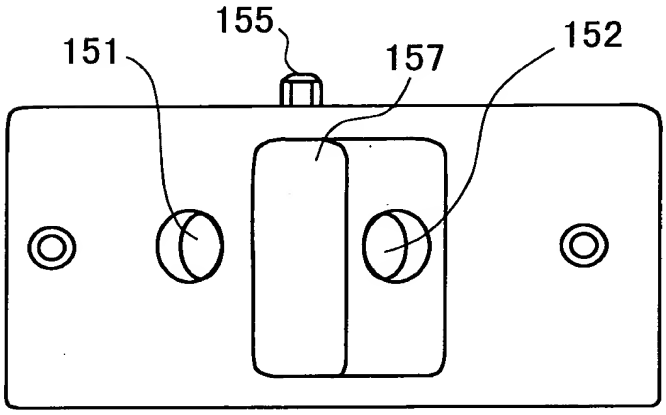
(b) bottom view

A view explaining the structure
of the sensor unit case provided with a shutter unit

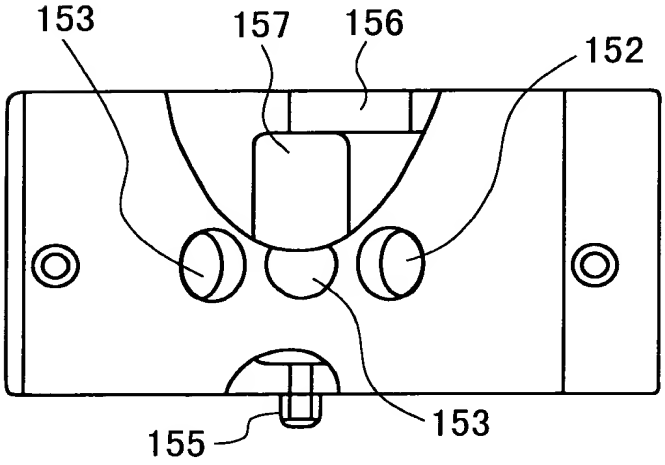
Fig.21



(a) front view

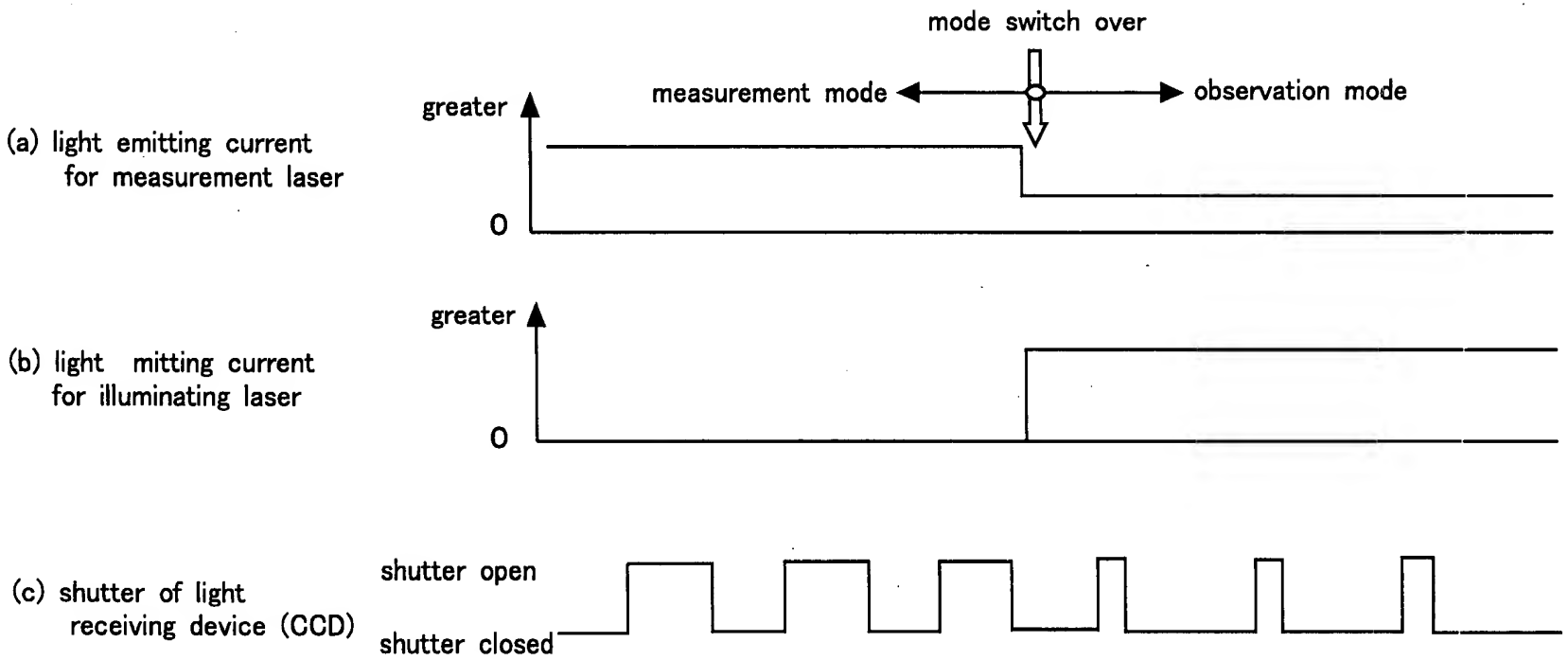


(b) top view



(c) bottom view

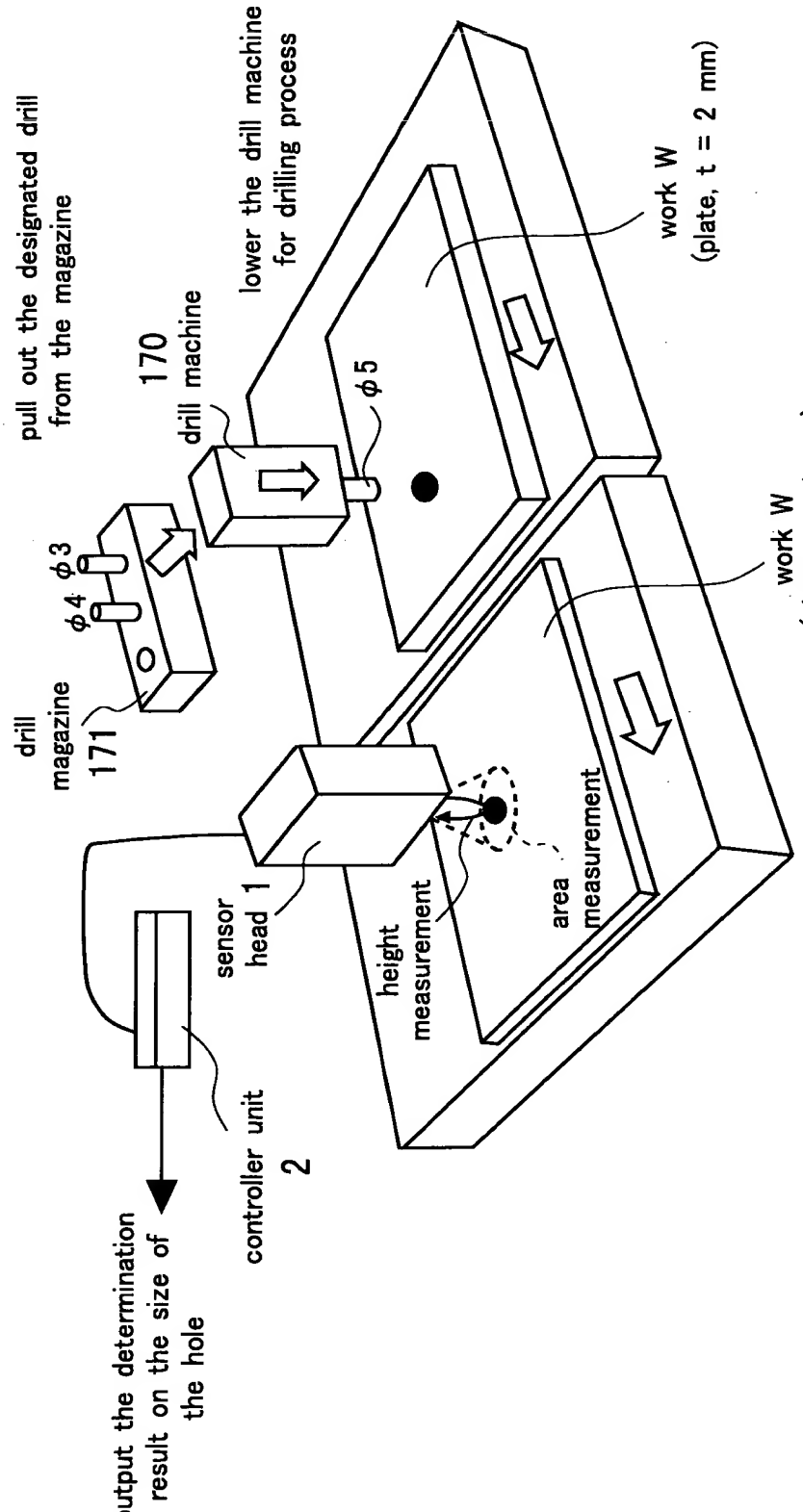
A view explaining the structure of the shutter unit



A view showing the operation of the measurement laser, LED for illumination and CCD both under the measurement mode and observation mode for comparison

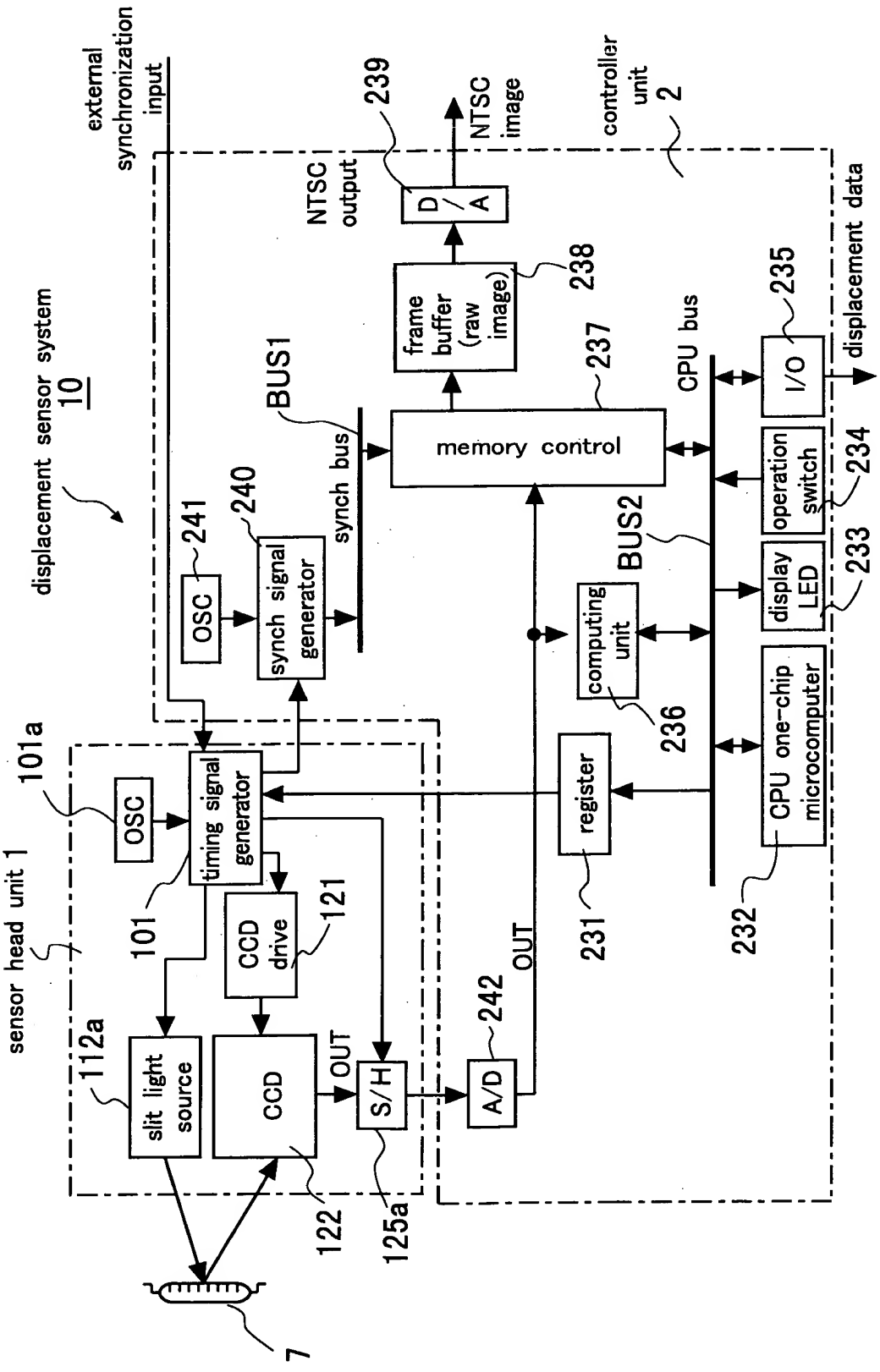
Fig.22

Fig.23



A view showing an exemplary application of the displacement sensor of the present invention

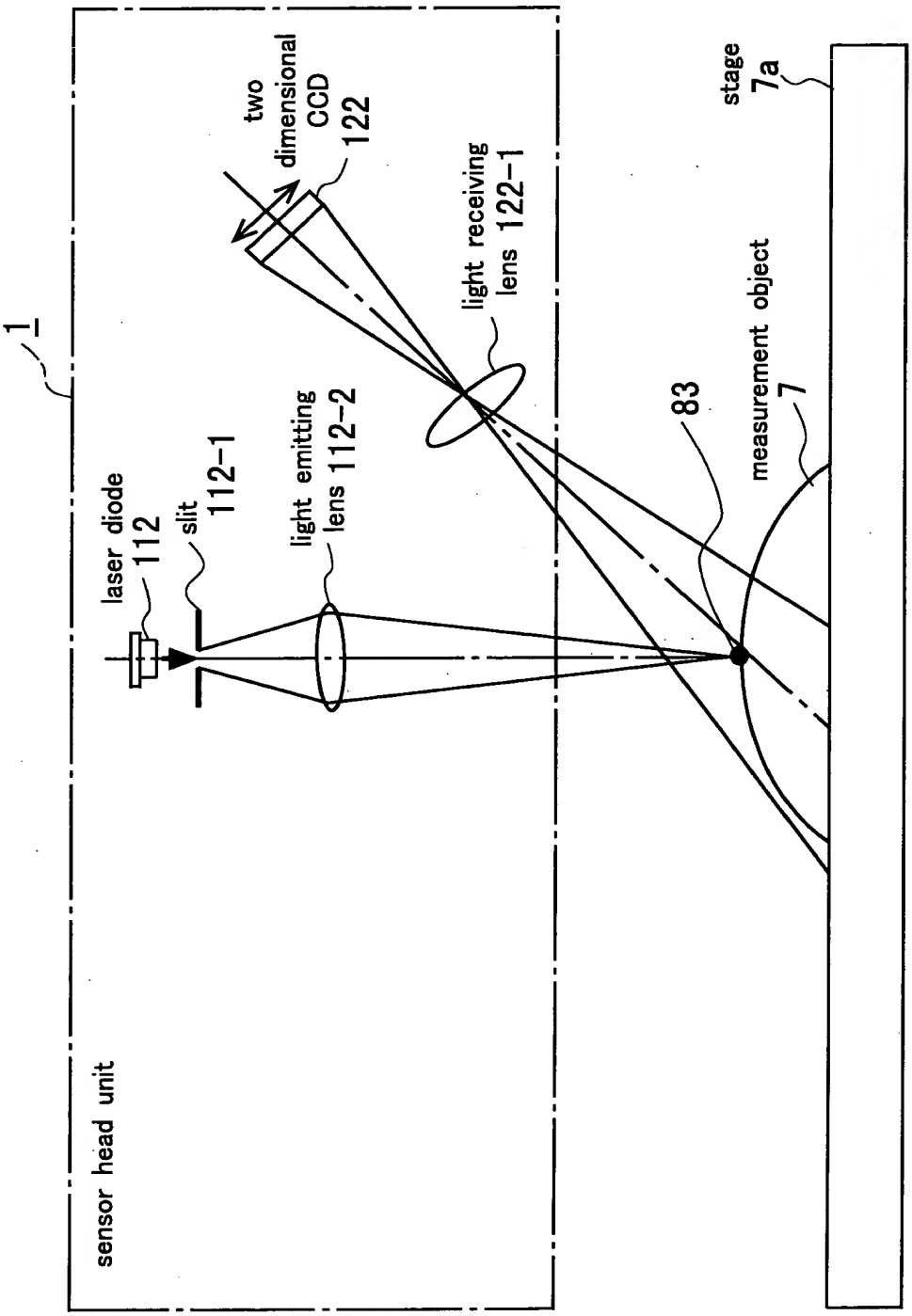
Fig.24



A block diagram showing the electric structure of the displacement sensor of the present invention

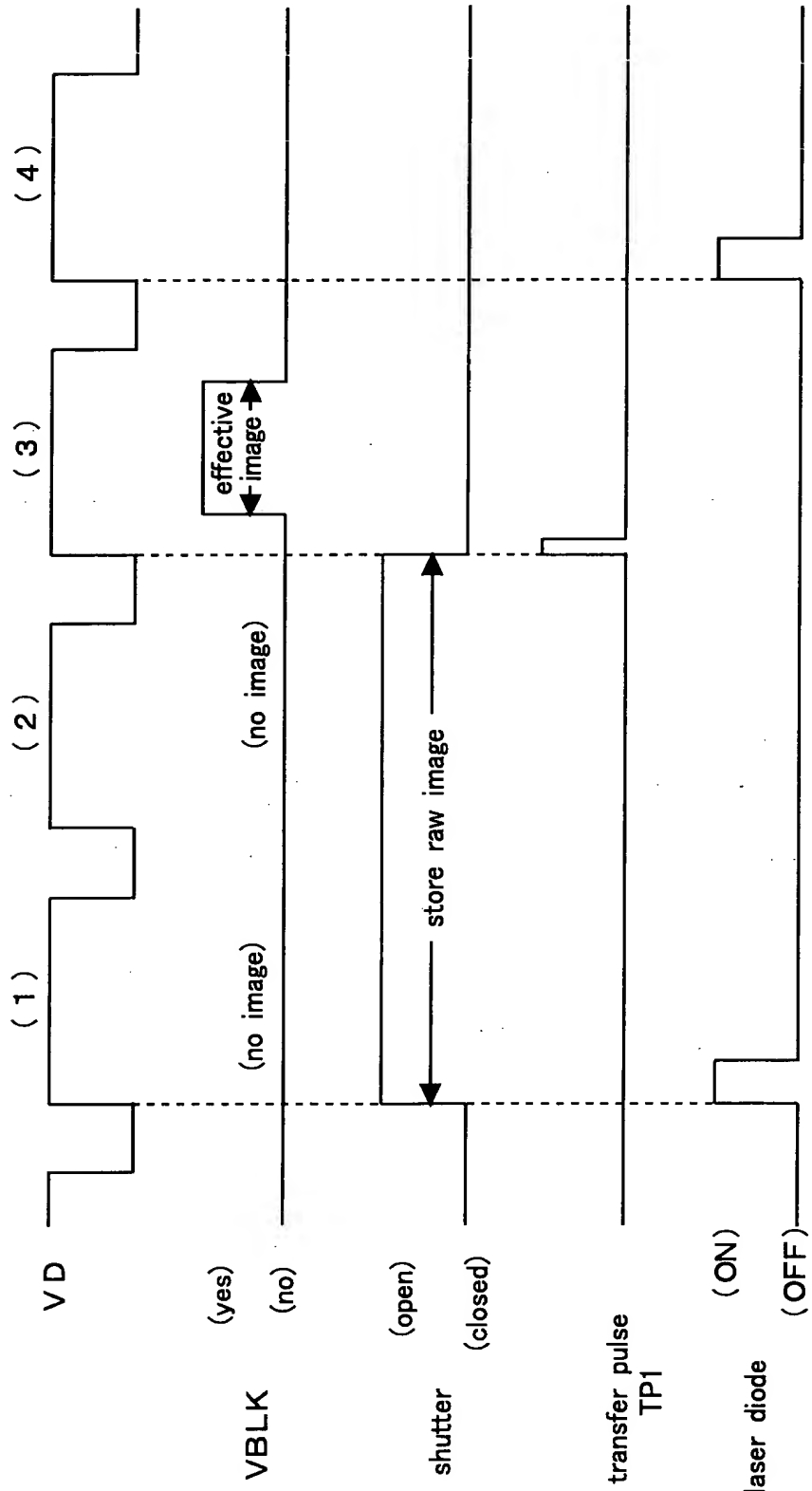
Title: DISPLACEMENT SENSOR
Inventor(s): Nobuharu ISHIKAWA et al.
Atty. Dkt. No.: 058856-0108

Fig.25



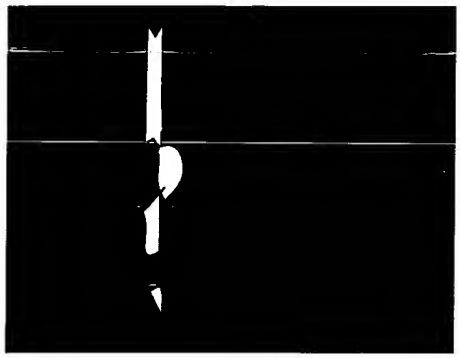
A diagram showing the optical system of the sensor head of the displacement sensor of the present invention

Fig.26

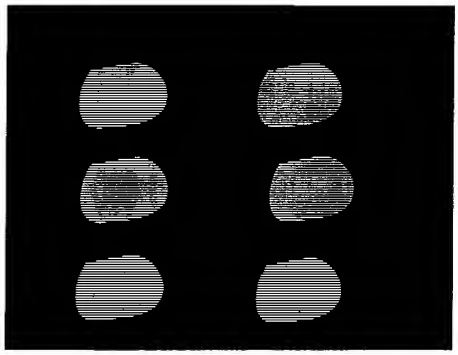


A time chart showing the process of superimposing a slit light image and a work surface image

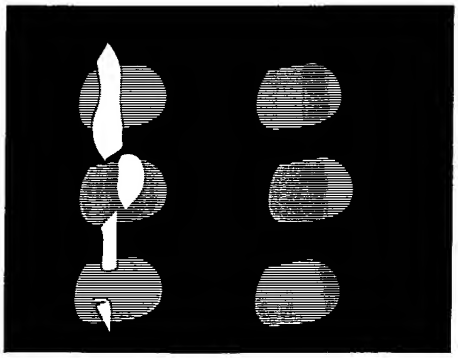
Fig.27



(a) slit light image



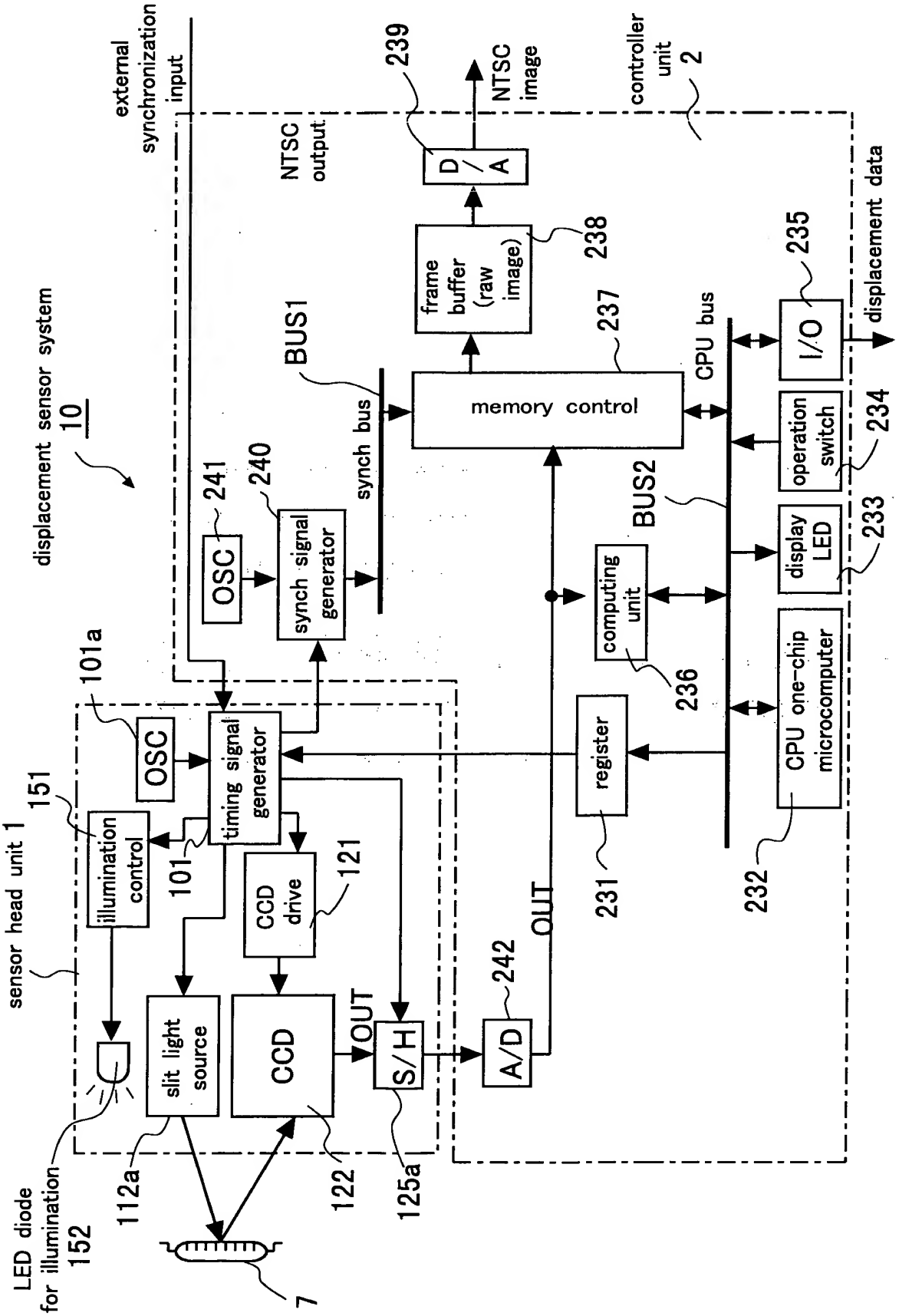
(b) work surface image



(c) superimposed image

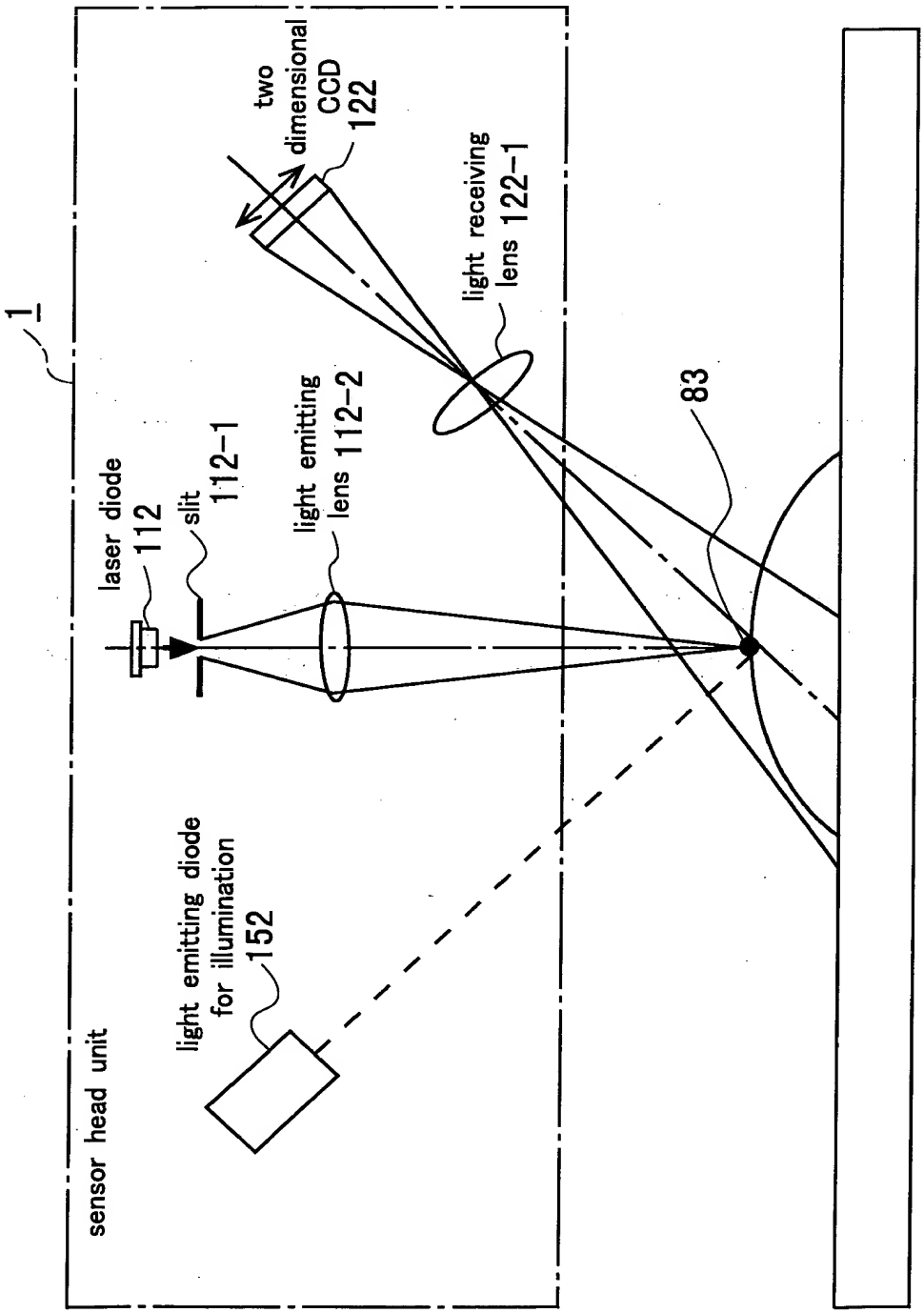
Views showing exemplary monitor images

Fig.28



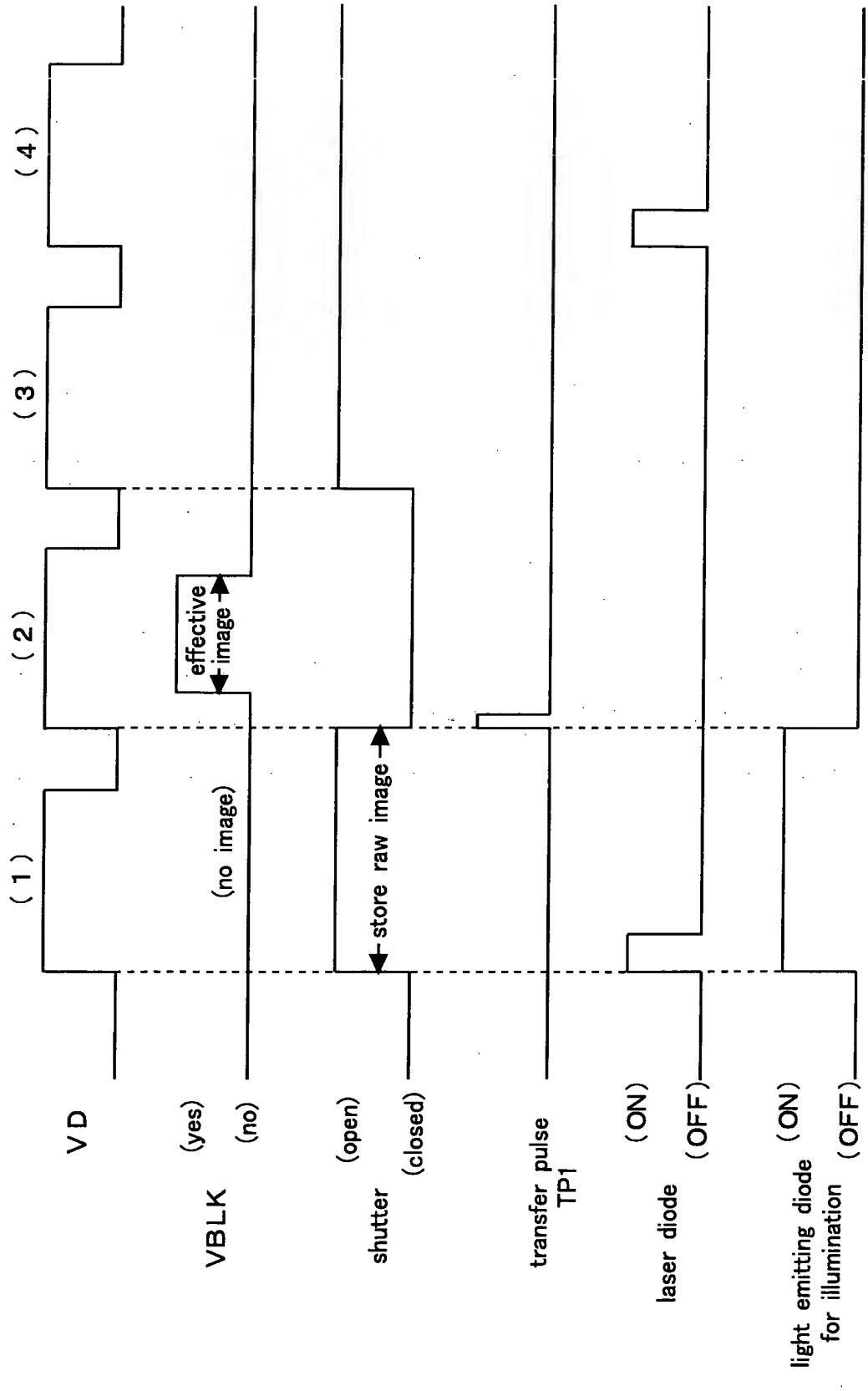
A block diagram showing the electric structure of the displacement sensor of the present invention

Fig.29



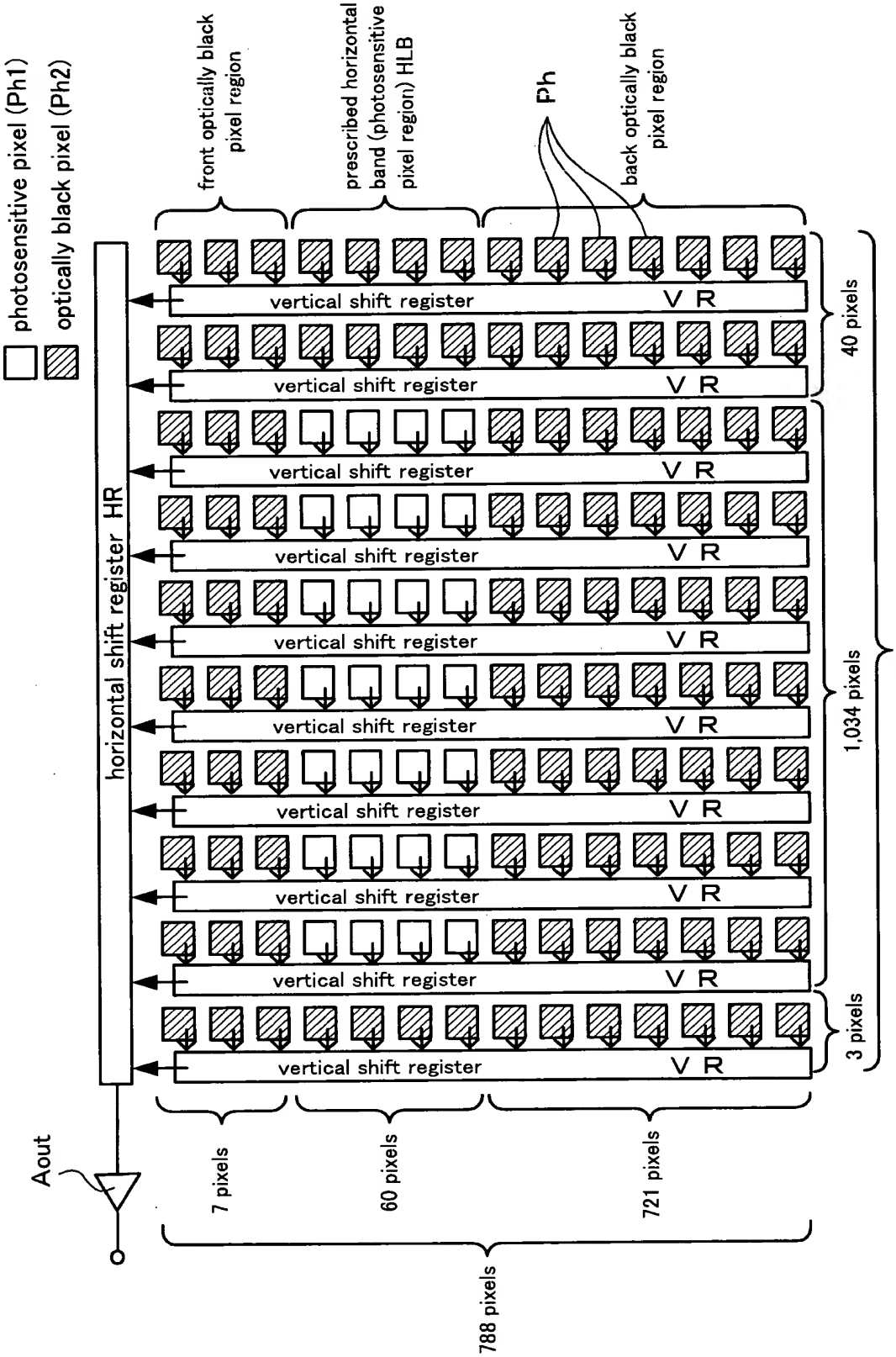
A diagram showing the optical system of the sensor head of the displacement sensor of the present invention

Fig.30



A time chart showing the process of superimposing a slit light image and a work surface image

Fig.31



A schematic view showing the pixel arrangement on the light receiving surface of the imaging device used in the imaging unit of the present invention

Title: [redacted]SPLACEMENT SENSOR
Inventor(s): Nobuharu ISHIKAWA et al.
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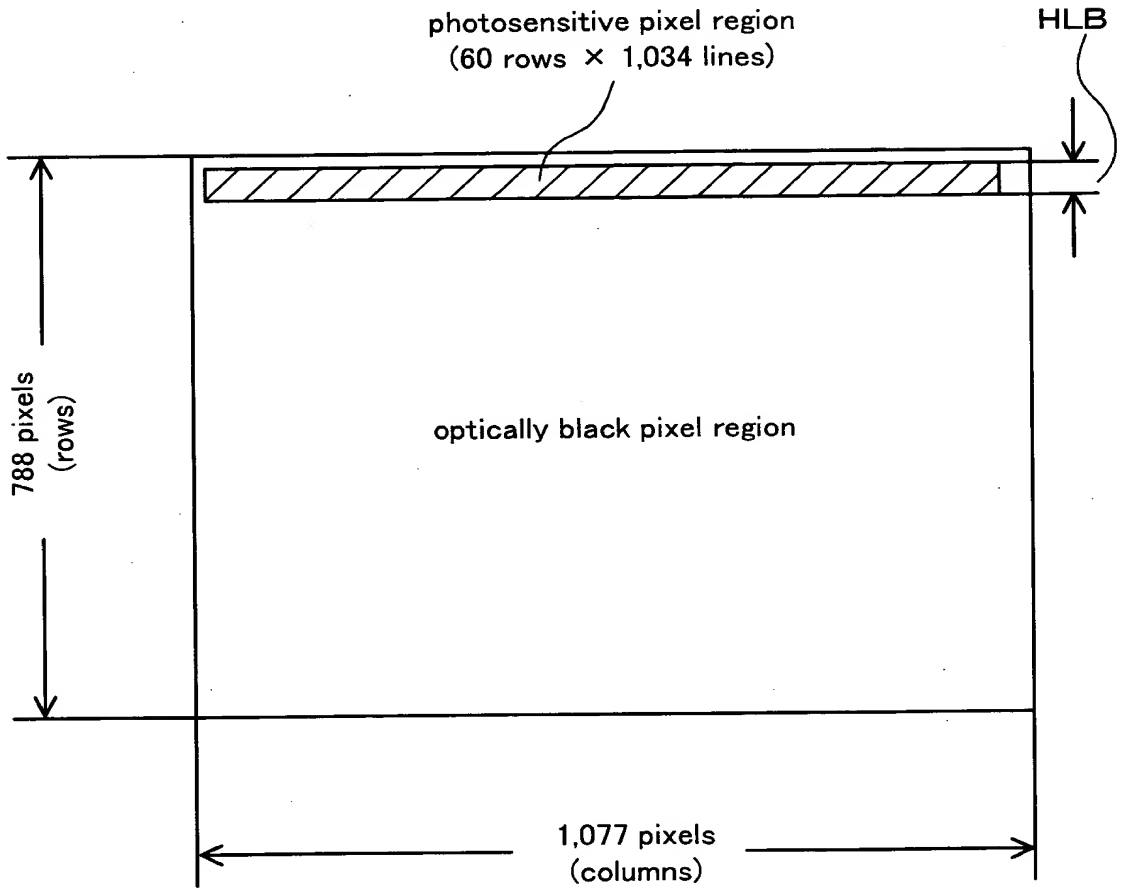
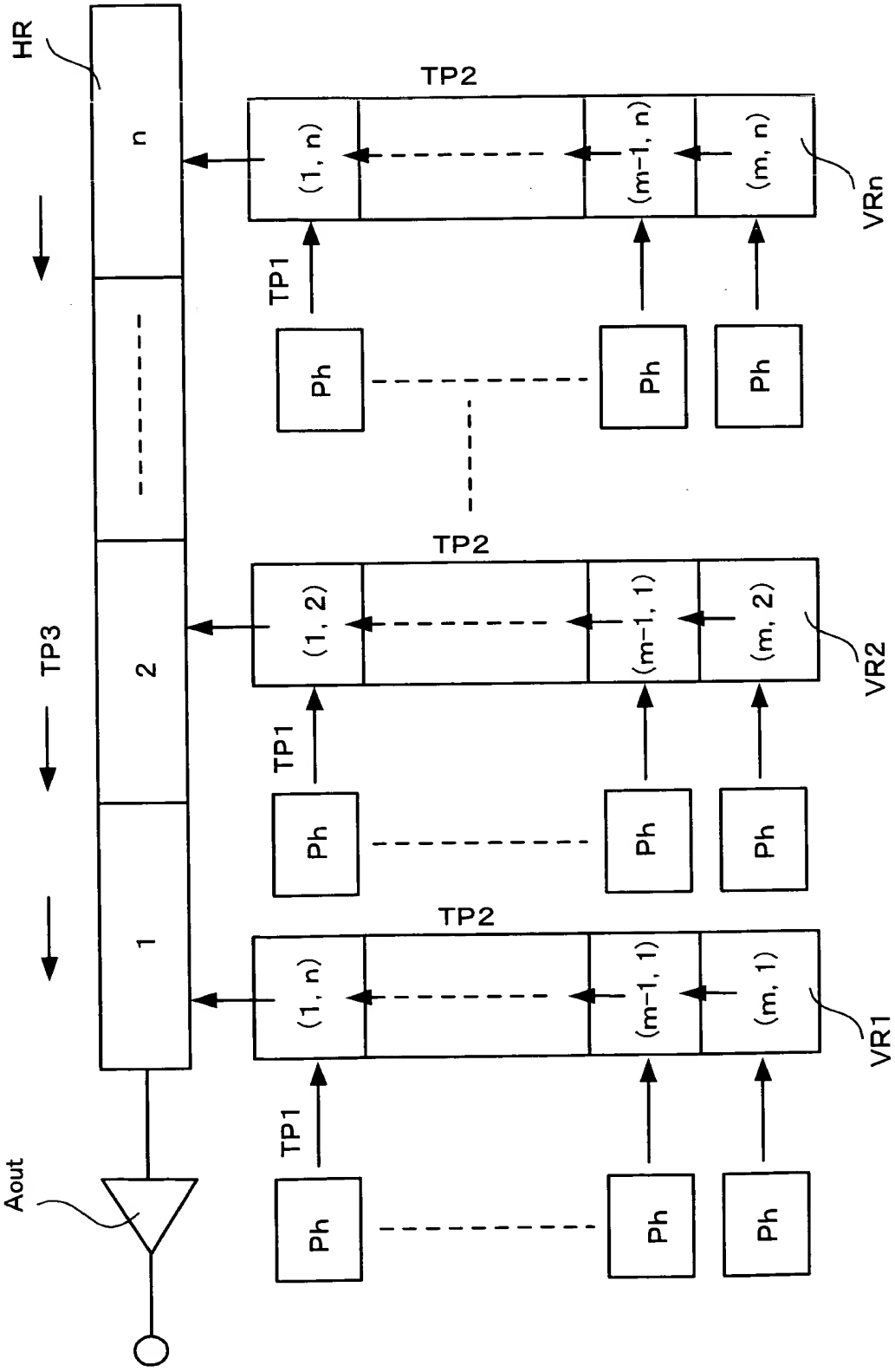
Fig.32



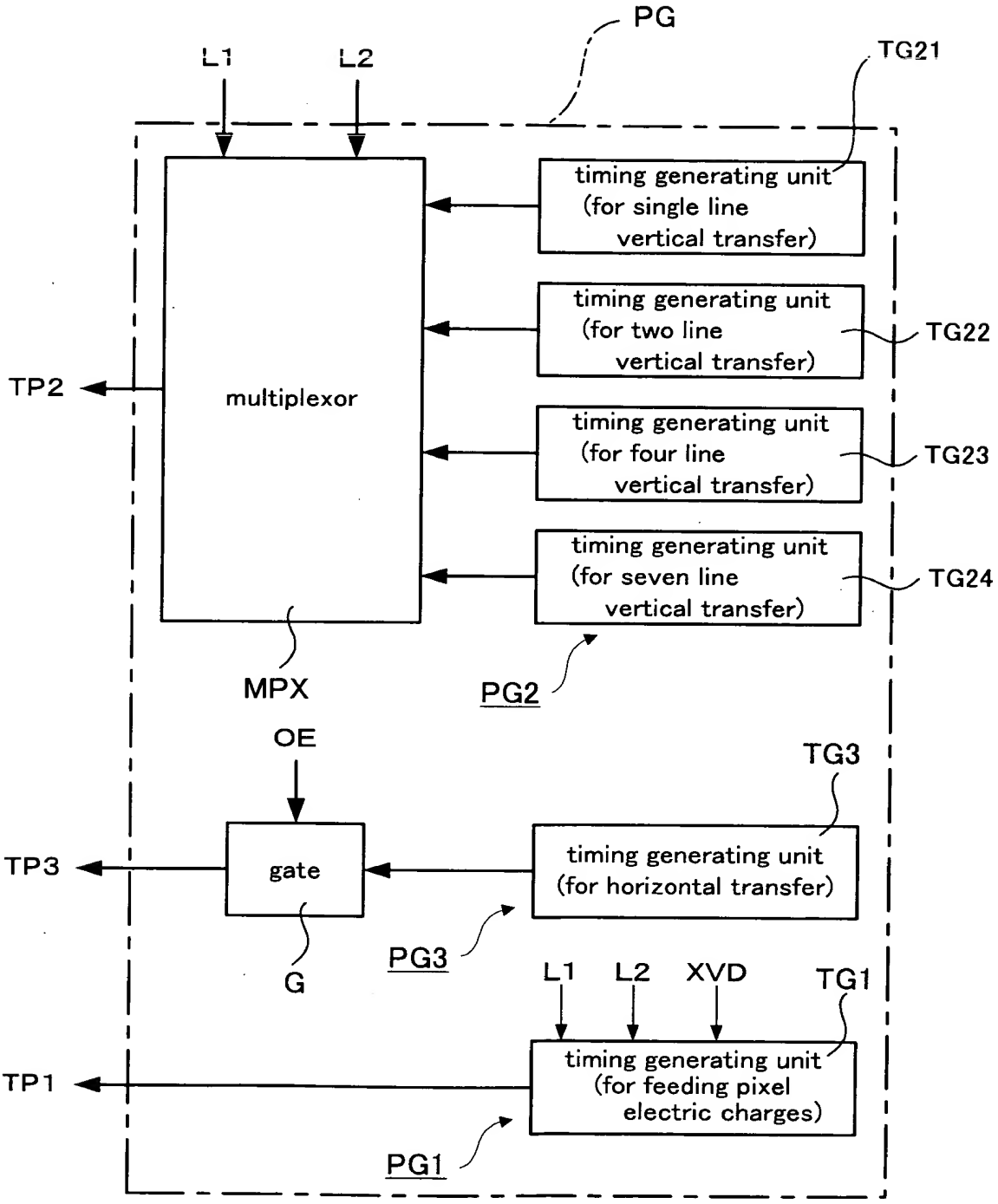
A diagram showing the relationship between the photosensitive pixel region and optically black pixel region of the imaging device used in the imaging unit of the present invention in an actual aspect ratio

Fig.33



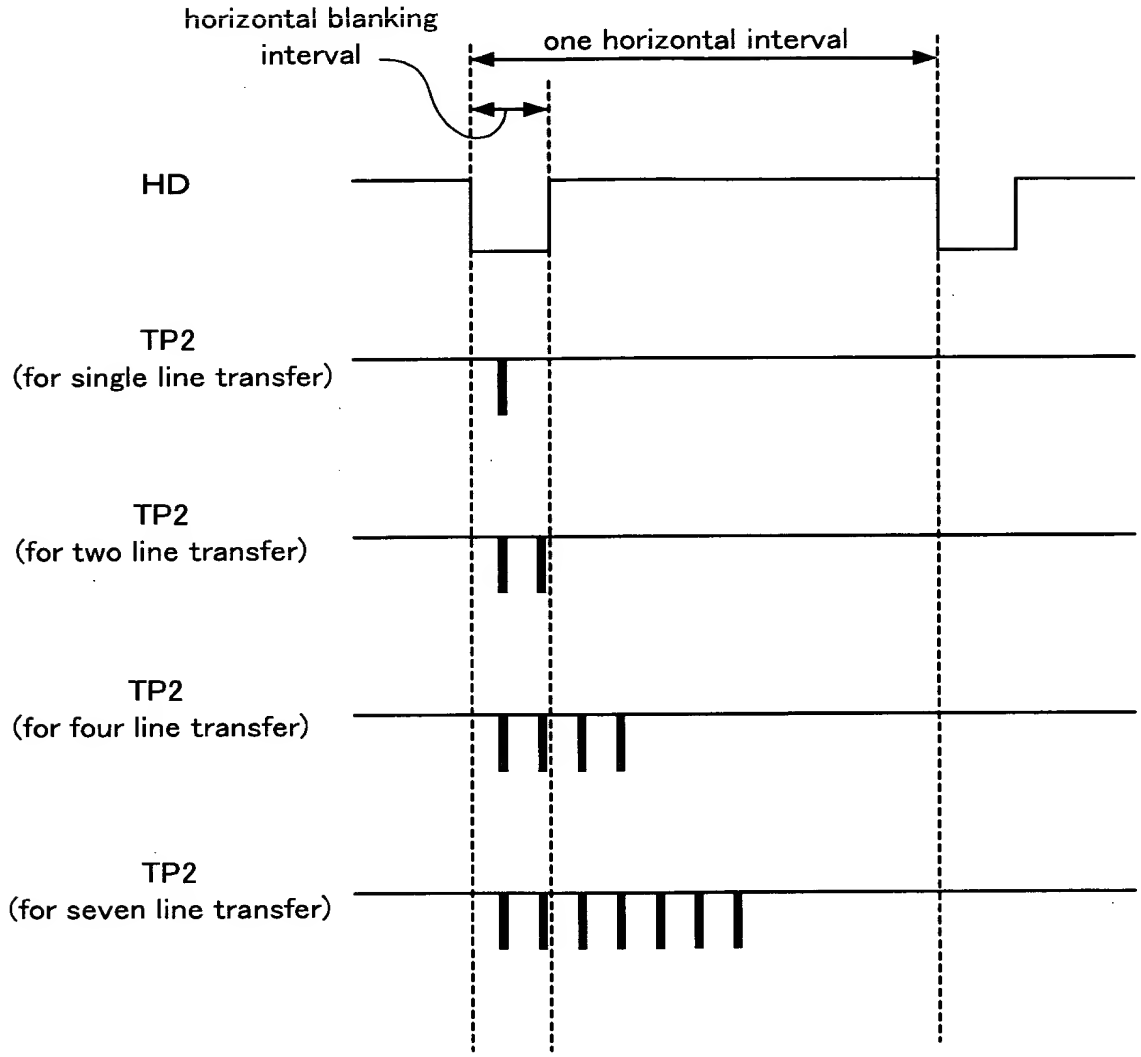
A block diagram describing the electric charge transfer circuit of the imaging device

Fig.34



A diagram showing the internal structure of the transfer pulse generating unit

Fig.35



A time chart showing the output mode of the transfer pulse (TP2)

Fig.36

horizontal interval counter value	L2	L1	OE
1	1	1	0
2	1	0	1
⋮	⋮	⋮	⋮
31	1	0	1

A diagram showing the content of the transfer protocol table

Fig.37

L1	L2	transfer line number
0	0	1
1	0	2
0	1	4
1	1	7

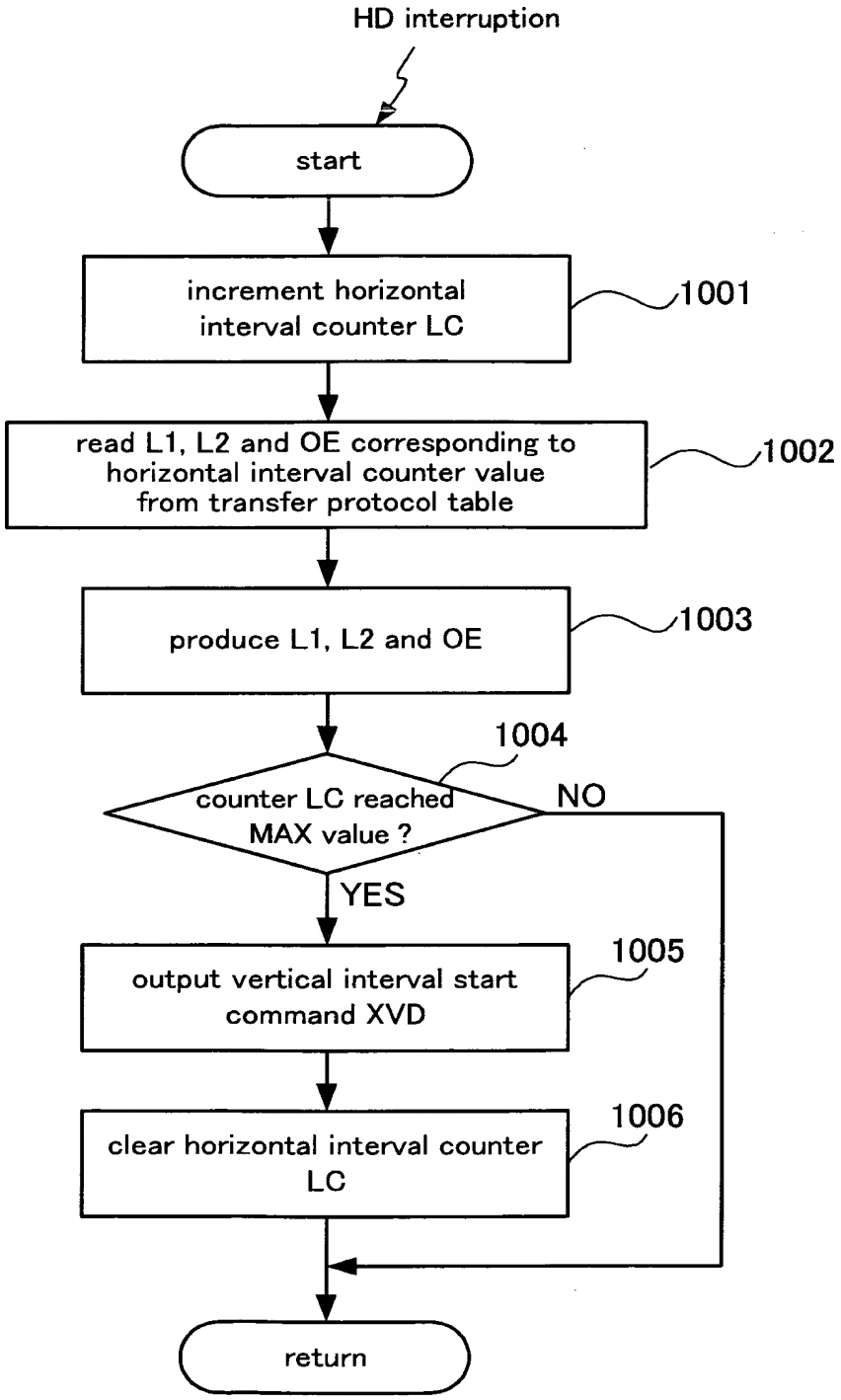
(a) relationship between the states of L1 and L2 and the transfer line number

OE	TP3 output
0	no
1	yes

(b) relationship between the state of OE and the TP3 output

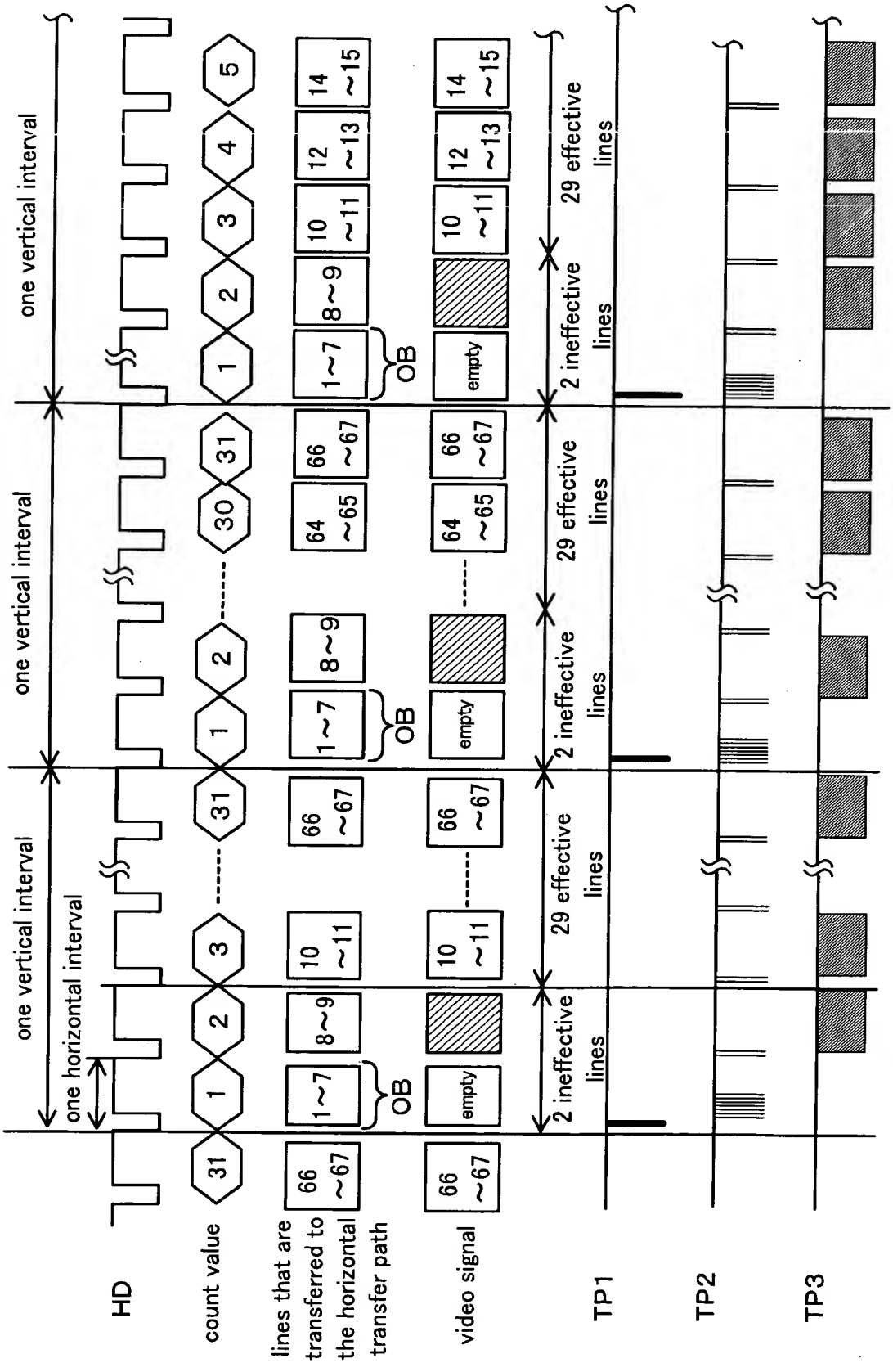
A diagram showing the contents of L1, L2 and OE

Fig.38



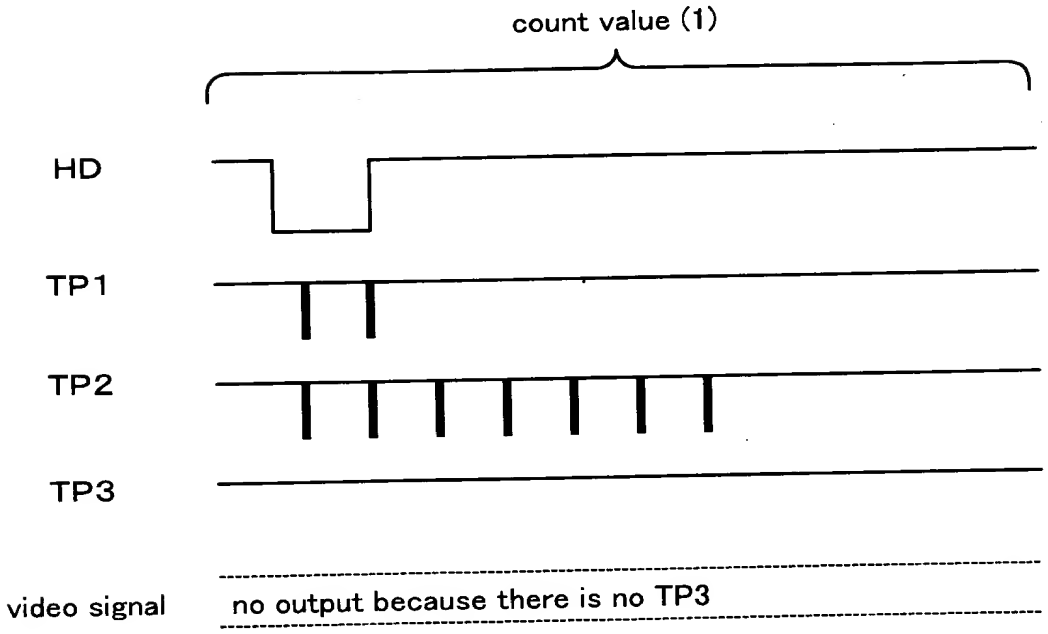
A flow chart showing the operation of the transfer control unit

Fig.39



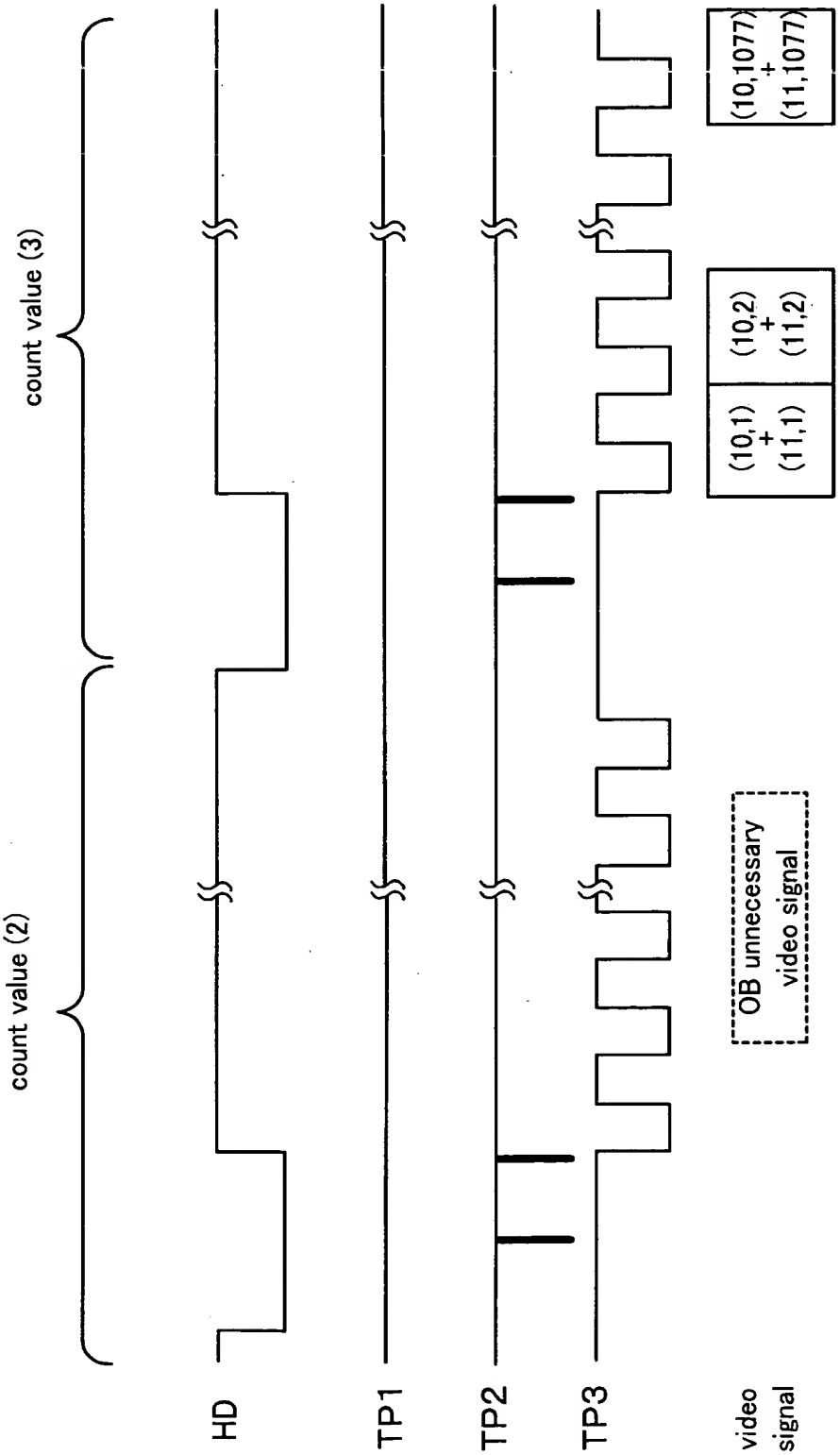
A time chart showing an exemplary drive mode of the imaging device

Fig.40



A view showing a part of the time chart of Figure 39

Fig.41



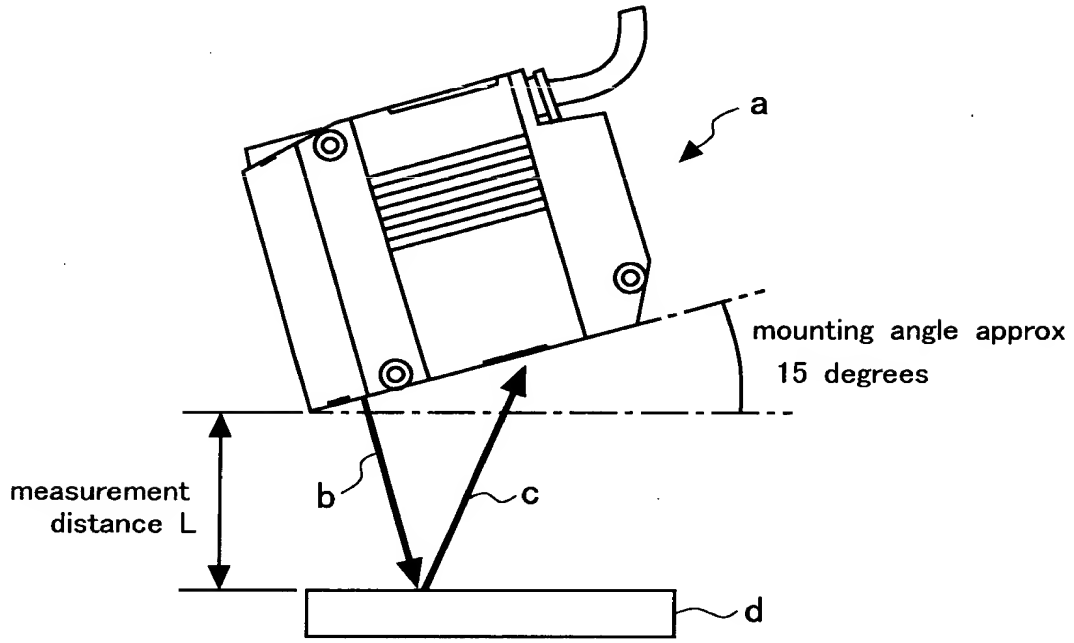
A view showing a part of the time chart of Figure 39

Fig.42

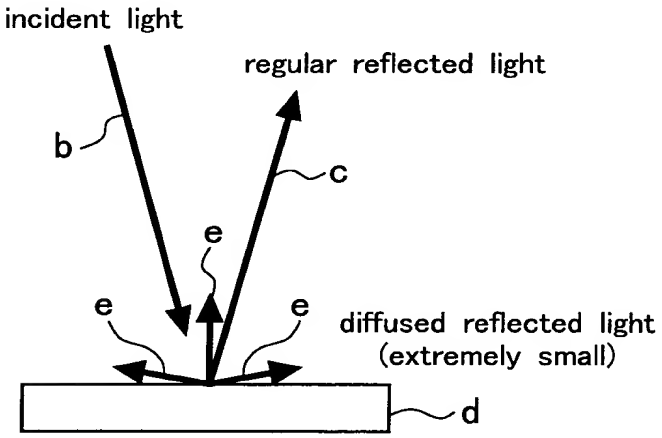
output line number	contents	
1	empty (no output)	ineffective image
2	sum of 9 horizontal lines 1 to 9	
3	sum of 2 horizontal lines 10 and 11	effective image
⋮	⋮	
31	sum of 2 horizontal lines 66 and 67	

A diagram showing the data structure of a single frame in an exemplary drive mode of the imaging device as a table

Fig.43



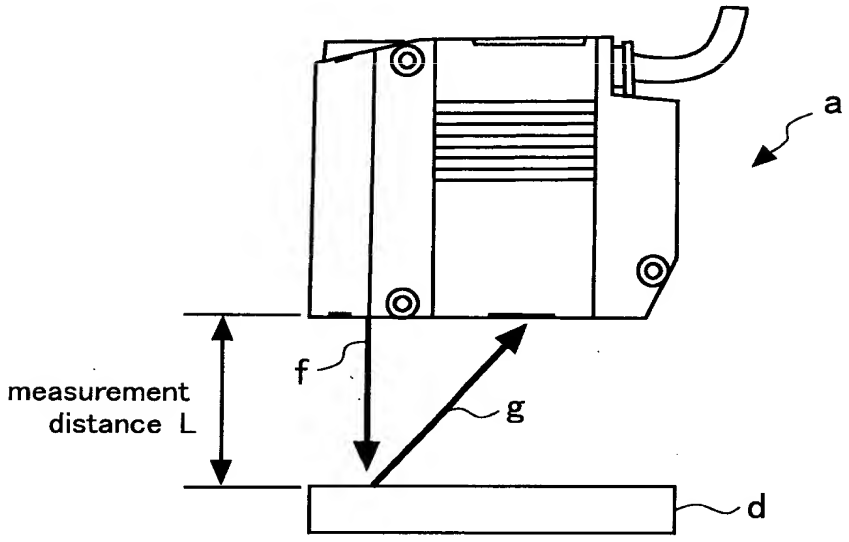
(a) light path for regular reflective surface object



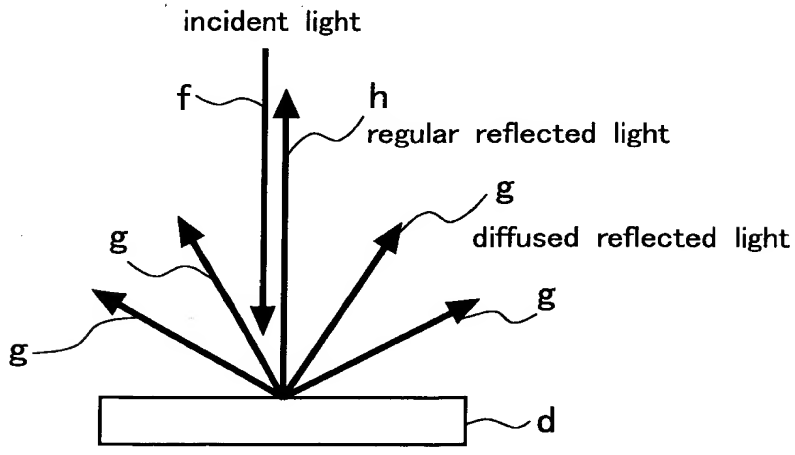
(b) mode of regular reflection

A diagram illustrating the optical system
of the displacement sensor for regular reflective objects

Fig.44



(a) light path for irregular reflective surface object



(b) mode of irregular reflection

A diagram illustrating the optical system
of the displacement sensor for irregular reflective objects